

**IN THE UNITED STATES DISTRICT COURT  
FOR THE DISTRICT OF NEW JERSEY**

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TEVA BRANDED PHARMACEUTICAL	:	Consolidated Civil Action No. 20-10172
PRODUCTS R&D, INC., and	:	(JXN)(MAH)
NORTON (WATERFORD) LTD.,	:	
	:	
Plaintiffs,	:	<u>CONFIDENTIAL –</u>
	:	<u>SUBJECT TO DISCOVERY</u>
v.	:	<u>CONFIDENTIALITY ORDER</u>
	:	
CIPLA LTD., AUROBINDO PHARMA LLC,	:	
AUROBINDO PHARMA USA, INC., and	:	
AUROLIFE PHARMA LLC,	:	
	:	
Defendants.	:	
	:	

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**OPENING EXPERT REPORT OF DR. REYNOLD A. PANETTIERI, JR., M.D.**

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## I. BACKGROUND AND QUALIFICATIONS

1. My name is Reynold A. Panettieri, Jr., M.D., and I am the Director of the Institute for Translational Medicine and Science and Vice Chancellor for Translational Medicine and Science at Rutgers University. I have been a Professor of Medicine at Rutgers's Robert Wood Johnson Medical School ("Rutgers Medical School") since 2015.

2. In addition to my teaching responsibilities, I am an attending physician at Rutgers Medical School in the areas of pulmonary and critical care medicine. I have more than 30 years of experience in the management of asthma patients. Over the past 30 years, I have treated over a thousand patients with asthma or chronic obstructive pulmonary disease ("COPD").

3. I also have extensive research experience as a respiratory pharmacologist and toxicologist. My research experience provides a unique perspective and expertise in the use of corticosteroids (e.g., beclomethasone dipropionate) and bronchodilators (e.g., albuterol sulfate) as therapies for treating patients with asthma and COPD.

4. I received a B.S. in Biology from St. Joseph's University in 1979, and I received an M.D. from the University of Pennsylvania in 1983.

5. I completed my internship in Internal Medicine at the Hospital of the University of Pennsylvania in 1989. I then completed my residency in Internal Medicine at the Hospital of the University of Pennsylvania later that year. I further completed a research fellowship in Pulmonary Diseases at the Hospital of the University of Pennsylvania in 1986.

6. I began teaching at the University of Pennsylvania Department of Medicine as an Assistant Professor in 1990, and I was named the Robert L. Mayock & David A. Cooper Professor in 2001. I continued in that role until 2015, when I became an Emeritus Professor. While at the University of Pennsylvania, I served as the Director of the Airways Biology Initiative from 2003 to 2015 and Director of the pulmonary function laboratory. These

laboratories conducted studies that measured the pulmonary function of patients with asthma and COPD. I also served as the Deputy Director for the Center for Excellence in Environmental Toxicology (CEET) from 2009 to 2015, and as Director for the Integrated Health Science Facility Core (the “Core”) from 2007 to 2015. The Core conducted human toxicology and pharmacological studies in environmental health that included asthma and COPD. Over the last 30 years, I have conducted translational research in how short acting bronchodilators such as ProAir® and beclomethasone (Qvar®) additively to alter airway smooth muscle function to improve bronchodilation in asthma and COPD.

7. I have received multiple awards for my work, including: the American Thoracic Society’s Joseph R. Rodarte Award for Distinguished Achievement and Contributions in Respiratory Physiology and Medicine, Respiratory Structure and Function Assembly (2013); the American Thoracic Society Recognition Award for Scientific Accomplishments (2015); and the American Lung Association and American Thoracic Society’s Career Investigator Award (1996).

8. I have served as the editor of several journals in the field of pulmonary medicine and respiratory science, including: Co-Editor-in-Chief: *Respiratory Research*; Associate Editor: *American Journal of Respiratory Cell & Molecular Biology*; and Associate Editor: *Frontiers in Pharmacotherapy of Respiratory Diseases*. Currently, I am a Senior Editor of the *British Journal of Pharmacology*, the leading global pharmacology journal. In addition, I have served on other editorial boards for journals related to pulmonary medicine and respiratory science, including: the *American Journal of Physiology: Lung Cellular and Molecular Physiology*; the *Journal of Pulmonary and Respiratory Medicine*; and *Therapeutic Advances in Respiratory Disease*. I have also served as a reviewer on multiple journals related to pulmonary medicine

and respiratory science, including: the *New England Journal of Medicine*; *Pulmonary Pharmacology & Therapeutic*; and the *American Journal of Respiratory & Critical Care Medicine*.

9. My work has focused on all aspects of pulmonary medicine. I have published almost 475 peer-reviewed original articles on respiratory diseases, in addition to publishing multiple book chapters, and other articles. I have given numerous presentations on asthma and COPD. I frequently am asked to opine on respiratory diseases on local and national television and prominent lay press. I have also consulted multiple biotech and pharmaceutical companies seeking to develop aerosols.

10. My curriculum vitae describing my professional experience, educational credentials, and publications are attached as Exhibit A to this report.

11. In forming my opinions, I have considered the materials cited in this report. I have also drawn upon my education, training, and experience.

12. I am being compensated at my standard hourly rate of [REDACTED] for work I perform in this matter. My compensation is not contingent on the outcome of the case. I have been retained by counsel for Teva Branded Pharmaceutical Products R&D, Inc. and Norton (Waterford) Ltd. (collectively, “Teva” or “Plaintiffs”) in this litigation.

13. In the past four years, I have testified at a hearing, at a trial, or by deposition in the following cases: *AstraZeneca v. Mylan*, C.A. Nos. 18-193-IMK, 19-203-IMK (N.D. W. Va.); *Black v. Allegheny*, C.A. No. 13-179-CRE (W.D. Pa.); *Schuster v. Villas of Lamplighter Condominium*, C.A. No. 2013-08241 (Ct. Common Pleas, Bucks County, Pa.); and *Gelety v. Weinrich et al.*, C.A. No. 15-5573 (E.D. Pa.).

14. In addition to the specific opinions set forth in this report, I may respond to additional testimony and information that becomes available during deposition, at trial, or otherwise, including any opinions put forth by Defendants' experts. I may also present a basic tutorial to explain the terms and concepts related to the opinions set forth in my expert report, and I may provide tables or exhibits to illustrate various aspects of my testimony. That tutorial may include demonstrative exhibits and models.

15. In addition to the opinions and bases set forth in this report, my testimony may include responses to facts, arguments, allegations, or references raised by Defendants or their experts relating to this litigation. I reserve the right to supplement my conclusions if additional information is provided to me, or if additional research leads me to conclude that supplementation is necessary.

## **II. ASSERTED PATENTS**

16. I have been informed that Teva has asserted the following patents and claims against Defendants Cipla Ltd. ("Cipla") and Aurobindo Pharma, LLC, Aurobindo Pharma USA, Inc., and Aurolife Pharma LLC (collectively, "Aurobindo"):

- a. U.S. Patent No. 9,463,289 (the "'289 Patent"), Claims 1-8
- b. U.S. Patent No. 9,808,587 (the "'587 Patent"), Claims 1-8, 11-22
- c. U.S. Patent No. 10,086,156 (the "'156 Patent"), Claims 1-2, 9, 11-13
- d. U.S. Patent No. 10,561,808 (the "'808 Patent"), Claims 1, 27-28

(collectively, the "Asserted Claims").

17. Each of the '289 Patent, '587 Patent, '156 Patent, and '808 Patent (collectively, the "Asserted Patents") claims priority to U.S. Provisional Patent Application Nos. 61/345,763 (the "'763 Provisional Application"), filed May 18, 2010, and 61/417,659 (the "'659 Provisional Application"), filed November 29, 2010. The Asserted Patents also name the following

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individuals as inventors: Declan Walsh, Derek Fenlon, Simon Kaar, Jan Geert Hazenberg, Daniel Buck, Paul Clancy, Robert Charles Uschold, and Jeffrey A. Karg.

18. I have been informed that Defendants contend that the inventions claimed by the Asserted Claims would have been obvious to the person of ordinary skill in the art (the “POSA”) as of the priority dates of the Asserted Patents.

19. I have been asked to provide opinions in this matter concerning the Asserted Claims. In particular, I have been asked to address whether certain objective indicia of non-obviousness are associated with the inventions claimed by the Asserted Claims, including whether the claimed inventions satisfied any long-felt, but unmet needs in the field of pulmonary medicine; whether others tried and failed to develop such solutions to those needs; whether the industry has accepted the claimed inventions; whether there has been any praise for the claimed inventions; and whether there has been any copying of the claimed inventions. I explain these concepts more fully below.

### **III. LEGAL STANDARDS**

#### **A. Person of Ordinary Skill in the Art**

20. I have been asked to assume that the POSA for the Asserted Claims, as of the Asserted Patents’ priority dates, would have had the skills, education, and expertise of a team of individuals working together to research, develop, and manufacture an inhalation aerosol product with a dose counter. Such a team would have included individuals with master’s degrees in mechanical engineering, design engineering, or related fields, with at least two years of post-graduate experience in developing inhalation aerosol products, or bachelor’s degrees in similar fields of study, with a commensurate increase in their years of postgraduate experience. Such a team also would have been familiar with a variety of issues relevant to researching, developing, and manufacturing inhalation aerosol products with dose counters. The team also would have

had access to an individual with a medical degree and experience in treating patients with inhalation aerosol devices.

21. For purposes of my opinion in this report, I have formed my opinions from the perspective of an individual with a medical degree and experience in treating patients with inhalation aerosol devices.

22. I have been informed that Cipla contends the POSA for the Asserted Claims would be a person with a bachelor's degree in pharmaceutical science or a related discipline, and having at least 2-3 years of product development experience with design and manufacture of metered dose inhalers. Alternatively, Cipla contends that the POSA would have a master's degree or Ph.D. in pharmaceutical science, mechanical or medical device engineering, or a related discipline, and at least 1-2 years of product development experience with metered dose inhalers. Cipla also contends that a POSA may have also worked as part of a multi-disciplinary team of scientists in pursuit of developing a pharmaceutical product and drawn upon not only his or her own skills, but also consulted with others of the team having specialized skills.

23. It is unclear to me how Cipla derived that definition of the POSA, and I disagree with it if and to the extent that it excludes physicians such as myself. Nevertheless, I note that in my experience, the kinds of multi-disciplinary teams mentioned in Cipla's definition generally include physicians experienced using those products—which, in this case, would include the use of inhalers with dose counters to treat asthma and other pulmonary diseases. Thus, my opinions would not change if I were to assume that Cipla's definition is correct.

24. I have been informed that Teva contends that the Asserted Claims of the '289, '587, '156, and '808 Patents are entitled to a priority date of no later than May 18, 2009; alternatively November 5, 2009; alternatively, no later than December 2, 2009; alternatively, no

later than March 16, 2010 (in the case of the '808 Patent only); alternatively, no later than May 18, 2010, the date on which U.S. Provisional Patent Application Nos. 61/345,763 was filed; alternatively, no later than November 29, 2010, the date on which U.S. Provisional Patent Application 61/417,659 was filed; and alternatively, no later than May 18, 2011, the date on which U.S. Patent Application No. 13/110,532 was filed.

25. I have applied these dates in my analysis. For purposes of my opinions, it does not matter which date between May 18, 2009, and May 18, 2011, is the ultimate priority date. My opinions would remain the same based on any priority date within that range.

26. Furthermore, I have been informed that Cipla contends that the Asserted Claims have a priority date of May 18, 2010. Assuming that priority date would not alter my opinions.

#### **B. Obviousness**

27. I have been informed that Defendants contend that the inventions of the Asserted Claims would have been obvious to the skilled person as of their respective priority dates. I have been informed that analysis of whether a claim would have been obvious depends on (a) the scope and content of the prior art, (b) the differences between the claimed invention and the prior art, (c) the level of ordinary skill in the art, and (d) any secondary considerations of non-obviousness. I have been informed that the use of hindsight must be avoided because the obviousness of an invention is evaluated from the perspective of the POSA at the time the invention was made. Thus, in conducting an obviousness inquiry, one must be aware of the distortion caused by hindsight bias and must be cautious to avoid reading into the prior art the teachings of the claimed invention at issue.

28. I have been informed that a proper obviousness analysis involves an evaluation of any secondary considerations of non-obviousness, also referred to as "objective indicia of non-obviousness." I have been informed that commonly recognized objective indicia include, among

other things, evidence of long felt but unsolved needs, failure of others, industry acceptance, and praise. I have been informed that the consideration of such objective indicia guards against hindsight bias and that, in appropriate circumstances, evidence of objective indicia may be determinative of the ultimate question of obviousness. I have been informed that, in order to affect the obviousness analysis, any objective indicia must have a sufficient nexus to the claimed invention(s).

#### **IV. CLAIM CONSTRUCTION**

29. I have been informed that claim construction refers to the process in which the Court determines the legal meaning of a patent's claims. I have been informed that a patent's claims should be construed according to their ordinary and customary meaning in view of the patent's specification and prosecution history, unless the patent defines a claim term, in which case that definition should be applied.

30. I have been informed that the parties have agreed to the following claim constructions.

No.	Term	Agreed-Upon Construction
1	"canister housing"  '289 patent, claim 1 '587 patent, claims 1, 12, and 13	"the portion of the inhaler body that is arranged to retain a medicament canister"
2	"inside surface"  '289 patent, claim 4 '587 patent, claims 4 and 17	"an interior surface"
3	"body"  '156 patent, claim 1	"the body of the inhaler"
4	"associated with"  '156 patent, claim 1	"related to"
5	"canister support formation"  '289 Patent, claims 1, 4	"a formation arranged to reduce canister rocking"

	'587 Patent, claims 1, 4, 11-13, 15	
6	"actuator"  '156 Patent, claims 1, 2, 12	"A structure within the dose counter that can be moved by the canister, is moveable relative to other components of the dose counter, and effectuates movement of at least one additional dose counter component."
7	"actuator pawl arranged to engage with a first tooth of the ratchet wheel"  '156 Patent, claim 1	"a pawl that is a part of the actuator of the dose counter that is arranged to engage with a tooth of the ratchet wheel."
8	"wall surfaces separating the canister receiving portion and the counter chamber"  '156 Patent, claim 1	"wall surfaces of the inhaler body which are substantially perpendicular to the direction of canister movement and which divide the canister-receiving portion and counter chamber"
9	"regulator"  '808 Patent, claims 1, 27	"a structure of the dose counter that modulates motion of the counter display"
10	"regulate motion of the counter display"  '808 Patent, claim 1	"modulate motion of the counter display"
11	"ratchet wheel"  '156 Patent, claims 1, 9, 12	"a wheel having a plurality of circumferentially spaced teeth arranged to engage with a pawl"
12	"first direction"  '808 Patent, claim 1	"single direction at a time"
13	"main surface of the inner wall"  '289 Patent, claim 1 '587 Patent, claim 1, 12, 13	"inside surface of the vertical cylindrical portion of the inhaler body, where vertical means substantially parallel to the primary direction of the movement of the medicament canister when it is pressed downward by the user to expel medicament"
14	"inner wall through which a portion of the actuation member extends"  '289 Patent, claim 3 '587 Patent, claims 3, 13	"an internal wall of the inhaler body that is horizontal, through which a portion of the actuation member extends, where horizontal means substantially perpendicular to the primary direction of the movement of the medicament canister when it is pressed downward by the user to expel medicament"
15	"inner wall"  '289 Patent, claims 1, 4	"an internal wall of the inhaler body, which includes a main surface of the inner wall and the inner wall through which a portion of the

	'587 Patent, claims 1, 4, 12, 13, 15, 21, 22	actuation member extends, but excludes the bottom surface, or floor, of the inhaler body"
16	"protects against unwanted actuation of the dose counter by reducing rocking of the medicament canister relative to the main body of the inhaler"  '587 patent, claim 1	"guards against unwanted actuation by reducing rocking of the medicament canister relative to the main body of the inhaler that would otherwise be of a magnitude sufficient to move the dose counter's actuator enough to cause unwanted incrementing (or decrementing) of the dose counter"

Joint Claim Construction Chart 3-5. I have applied these constructions in the course of rendering my opinions set forth below.

31. I have been informed that the parties dispute the meaning of the following claim terms and have proposed competing constructions. I have been informed that the Court has yet to rule on these disputes.

<b>No.</b>	<b>Term</b>	<b>Plaintiffs' Construction</b>	<b>Defendants' Construction</b>
1	"actuation member"  '289 Patent, claims 1, 3  '587 Patent, claims 1, 3, 11, 12, 13  '156 patent, claims 12	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  "a component of the dose counter's actuator that transmits motion from the canister to the actuator"	"pin arranged to engage with a medicament canister and effect movement causing the dose counter to record a count"
2	"[lying or lie] in a common plane coincident with the longitudinal axis X"  '289 Patent, claim 1  '587 Patent, claims 1, 12, 21, 22	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  Features lie on a common plane coincident with the longitudinal axis X if it is possible to draw a straight line connecting those features that passes through the center of the stem block.	"aligned in a single plane such that a straight line can be drawn through the center of the central outlet port, a canister support formation located directly adjacent to the actuation member, and the actuation member"

3	<p>“positioned at opposite ends of the inside surface of the main body to face each other”</p> <p>’289 Patent, claim 7</p> <p>’587 Patent, claims 7, 18</p>	<p>Plain and ordinary meaning in view of the claims, specification, and prosecution history.</p> <p>“located on opposite sides from one another on the inside surface of the main body, and extending outwardly from the inner wall towards each other”</p>	<p>“positioned directly across from one another such that a straight line can be drawn from one support rail through the center of the longitudinal axis X to the facing support rail”</p>
4	<p>“step[(s)] formed thereon”</p> <p>’289 Patent, claims 5, 8</p> <p>’587 Patent, claims 5, 8, 16, 19</p>	<p>Plain and ordinary meaning in view of the claims, specification, and prosecution history.</p> <p>“a location of changing width dimension thereon”</p>	<p>“A stepwise increase in the extent to which the support rail extends inwardly”</p>
5	<p>“first reset position”</p> <p>’156 Patent, claim 1</p>	<p>Plain and ordinary meaning in view of the claims, specification, and prosecution history.</p> <p>“a position of the actuator in which the actuator pawl is brought into engagement with the first tooth of the ratchet wheel and which is before the canister fire configuration”</p>	<p>“configuration in which the actuator pawl is above the datum plane, but closer to the datum plane than in the start configuration, and is just engaged with one of a tooth of the ratchet wheel”</p>
6	<p>“canister fire sequence”</p> <p>’156 Patent, claim 1</p>	<p>Plain and ordinary meaning in view of the claims, specification, and prosecution history.</p> <p>“a sequence of configurations and positions that occur before, while, and after the medicament canister fires medicament”</p>	<p>“process of ejecting medicament from an inhaler where the actuator pawl follows a particular sequence of movement from the start configuration to the reset configuration, to the [fire configuration as, to the count configuration, before returning to the start configuration upon release of pressure on the canister, where in the start configuration, prior to depression of the canister, the count pawl is engaged with a tooth of the ratchet wheel and</p>

			the actuator pawl is spaced from the ratchet wheel.”
7	“canister fire configuration”  '156 Patent, claims 1, 2	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  “a configuration of the dose counter in which the medicament canister fires medicament”	“configuration in which the actuator pawl is lower than in the first reset position and below the datum plane and the medicament is ejected”
8	“count configuration”  '156 Patent, claims 1, 2	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  “a configuration of the dose counter whereby the dosage indicator has indicated a count”	“configuration in which the actuator pawl is further below the datum plane than when in the canister fire position and the dose counter has counted one dose”
9	“datum plane which passes through a shoulder of a valve stem block configured to receive the medicament canister”  '156 Patent, claim 1	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  “a plane that passes through a shoulder of the portion of the inhaler body that engages the valve stem and is perpendicular to the direction of movement of the medicament canister”	“plane or line passing through the bottom surface of a structure into which the valve stem of a medicament canister is inserted, wherein the bottom surface is where the valve stem block meets a passageway to a nozzle for directing the canister contents towards an air outlet”
10	“the body”  '156 Patent, claim 12	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  “inhaler body” - '156 Patent, 22:64, 67  “dose counter body” - '156 Patent, 22:66	This term is indefinite.
11	“counter display arranged to indicate dosage information”	Plain and ordinary meaning in view of the claims, specification, and prosecution history.	“structure displaying the number of doses remaining”

	'808 Patent, claim 1	"a component of the dose counter that displays information regarding the number of doses remaining"	
12	"first station" '808 Patent, claim 1	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  "a first region"	"first structure on which the counter is located"
13	"second station" '808 Patent, claim 1	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  "a second region"	"second structure, separate from the first structure, to which the counter display is moved"
15	"aperture" '289 Patent, claim 3 '587 Patent, claims 3, 13, 20-22	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  "an opening or open space: hole"	"hole"
16	"separate counter chamber" '156 Patent, claim 12	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  "a separate chamber of the inhaler in which the dose counter is located"	"discrete space or cavity defined by the main surface of the inner walls and the inner wall through which a portion of the actuation member extends in which the dose counter is located"
17	"count pawl" '156 Patent, claims 1, 9	Plain and ordinary meaning in view of the claims, specification, and prosecution history.  "a pawl that is a component of the dose counter that is capable of engaging with a second tooth of the ratchet wheel"	"a pawl that is part of the dose counter, separate from an actuator pawl, that is arranged to engage with a second tooth different from the first tooth of the ratchet wheel"

Joint Claim Construction Chart 6-10.

32. My opinions as set forth below would not change if either side's proposed constructions were adopted by the court. That is, my opinions do not depend on the court's adoption or rejection of any of the constructions set forth above, and would not change if the Court adopted, for example, any or all of Defendants' proposed constructions. I have no opinion on the correctness of either side's proposed constructions.

**V. SUMMARY OF OPINIONS**

33. The following paragraphs summarize my opinions in this matter. This summary is not meant to limit the opinions expressed in detail below, but instead to provide a general overview of the subject matter of my testimony.

34. The inventions claimed by the Asserted Claims satisfied multiple, long-felt, unmet needs in the field of pulmonary medicine, including the need for inhalers with dose counters with sufficient functionality, accuracy (including, with respect to under- and over-counting), reliability, maintainability (and ability to be cleaned), robustness, manufacturability, minimal impact on device performance, and human factors (including aesthetics, ergonomics, and other human factors).

35. Other scientists and companies had tried, but failed to research and develop inhalers with dose counters with the properties of the claimed inventions, including inhalers having does counters with sufficient functionality, accuracy (including, with respect to under- and over-counting), reliability, maintainability (and ability to be cleaned), robustness, manufacturability, minimal impact on device performance, and human factors (including aesthetics, ergonomics, and other human factors).

36. The inventions claimed by the Asserted Claims have received industry recognition.

37. The inventions claimed by the Asserted Claims have received praise from patients and doctors in the industry. In my experience, both patients and doctors have told me that Qvar® HFA with dose counter and ProAir® HFA with dose counter are sleek, user-friendly devices, which fit easily in a patient's hands, and reliably provide information on the number of doses remaining in their medicament canisters. By contrast, prior art devices did not provide reliable and objective measures by which a patient could tell how many doses were remaining in the canister. Indeed, many of my patients who did not use Qvar® HFA with dose counter or ProAir® HFA with dose counter would regularly lose track of how many doses remained in their devices. As a result, the patients would use their inhalers even though they contained little or no medication (sometimes for several weeks at a time) and would have to resort to using their rescue inhalers more often. In my experience, devices such as Qvar® HFA with dose counter and ProAir® HFA with dose counter enabled patients to have more control in treating their medical conditions that led to fewer medical emergencies. In addition, devices such as Qvar® HFA with dose counter and ProAir® HFA with dose counter allow treating physicians like myself to more accurately determine whether a patient is adhering to his or her medical regimen.

38. The inventions claimed by the Asserted Claims have been copied by others in the field of pulmonary medicine. In particular, Aurobindo and Cipla chose to copy the Asserted Claims by seeking from the U.S. Food & Drug Administration ("FDA") approval to market generic versions of Qvar®, which is an embodiment of the claimed inventions.

39. Each of the above objective indicia, alone and/or in combination, support the nonobviousness of the Asserted Claims.

## VI. OBJECTIVE INDICIA OF NON-OBVIOUSNESS

### A. Multiple Long-Felt, Unmet Needs

40. The claimed inventions satisfied multiple, long-felt needs in the field of pulmonary medicine. These needs include needs for inhalers with dose counters that had sufficient functionality, accuracy (including, with respect to under- and over-counting), reliability, maintainability (and ability to be cleaned), robustness, manufacturability, minimal impact on device performance, and human factors (including aesthetics, ergonomics, and other human factors). Each of these needs was satisfied alone and/or in combination by the claimed inventions.

41. Inhalation medications, such as Qvar® HFA and ProAir HFA®, treat conditions like asthma and other respiratory diseases by helping prevent chronic symptoms, maintain lung function, and reduce acute episodes in patients. *See* Qvar® HFA Label (May 22, 2014), TEVAQVAR-00010727; ProAir® HFA Label (Mar. 7, 2012), TEVAQVAR-00066638.

42. As of the priority date, pressurized metered dose inhalers (“pMDIs”) were used to treat various pulmonary indications. However, very few pMDIs had adequate dose counters—in particular, few had dose counters that had sufficient functionality, accuracy (including, with respect to under- and over-counting), reliability, maintainability (and ability to be cleaned), robustness, manufacturability, minimal impact on device performance, and human factors (including aesthetics, ergonomics, and other human factors).

43. As described in more detail below, the absence of pMDIs with satisfactory dose counters prevented patients from tracking the number of remaining doses, leading them to either throw away inhalers that still contained doses or use inhalers that had been used more times than the recommended number of doses, resulting in waste or potentially life-threatening situations.

*See, e.g., FDA Guidance 2003, TEVAQVAR-00032573, at -577-78; '289 Patent, 1:27-2:37;*

Ogren 1995, TEVADOC-00000011, at -11-15; Broeders 2009, TEVADOC-00000001, at -03;  
Fink 2005, CIPLA-BDI\_0784184; Sander 2006, TEVADOC-00000046; Hess 2008, at 710; Carr  
Dep. Tr. 16:12-21.

44. The dose counters and dose indicators disclosed by the prior art suffered from several flaws. Dose indicators failed to precisely track the number of doses remaining in the inhaler. However, as described below in greater detail, they lacked adequate functionality, accuracy (including, with respect to under- and over-counting), reliability, robustness, manufacturability, acceptable aesthetics and/or ergonomics, were difficult to clean, altered device performance, and/or were overly expensive and/or susceptible to human factors. *See, e.g.*, '289 Patent, 1:27-2:37; '021 Publication, ¶ [0006]. The industry thus had a long-felt, unmet need for inhalers with dose counters that solved each of these problems individually, as well as a long-felt, unmet need for superior inhalers and dose counters that solved two or more of these problems collectively. Moreover, many prior art dose counters were only available in conjunction with specific drug products.

**1. As of the Priority Date, There Were Multiple, Long-Felt, Unmet Needs for Devices with the Properties of the Claimed Inventions.**

45. The prior art emphasized several problems with the available devices and methods. First, the prior art recognized that there was a long-felt, unmet need for inhalers with dose counters that provided the functionality of the claimed inventions.

46. Many prior art inhalers did not include any mechanisms to track the number of doses expended or remaining, and patients thus faced “difficulty” in “determining the number of doses remaining in the device.” Hess 2008, at 710. Patients using inhalers without dose counters thus resorted to various methods in an effort to monitor the amount of medication remaining in their canisters. *see, e.g.*, Holt 2005, at 105-06. For example, patients would

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(1) float the canister in a bowl of water (i.e., the float test), (2) shake the canister, (3) test fire the inhalers, (4) evaluate the taste or feel of the spray, *see id.* at 105, and/or (5) count the number of doses on a piece of paper, *see* Fink 2005, CIPLA-BDI\_0784184, at -189; Sander 2006, TEVADOC-00000046, at -49-50.

47. Expectantly, these methods were unreliable. FDA Guidance and experts in the field, for example, questioned the accuracy of the float test and noted that placing the canister in water reduced its effectiveness. *See, e.g.*, Sander 2006, TEVADOC-00000046, at -49-50; Ogren 1995, TEVADOC-00000011, at -13 (“The universal accuracy of this flotation technique has been questioned by others and the results of our sample concur with this concern. In the metered-dose inhalers tested, the commonly used flotation technique did not identify a universal flotation status that accurately indicated when all metered dose inhalers should be replaced.”); Fink 2005, CIPLA-BDI\_0784184, at -189 (“Not only does [the float test] not work reliably, but water entering the nozzle can radically reduce the subsequent dose, so floating the canister is no longer a recommended technique by most in the industry.”); FDA Guidance 2003, TEVAQVAR-00032573, at -577 (similar); Hess 2008, at 710 (reporting that float-test “is unreliable and should not be used”).

48. Likewise, several studies revealed that shaking the canister or test-firing the inhaler were also unreliable. *See, e.g.*, Holt 2005, at 105-06 (concluding that patients who used shaking method overestimated amount of medicament remaining by about 40 doses); Sander 2006, TEVADOC-00000046, at -49-50; FDA Guidance 2003, TEVAQVAR-00032573, at -577 (“Various means of *testing* the inhalers (e.g., shaking the canister) are unreliable . . .”); *accord* Hess 2008, at 710 (similar). Moreover, studies concluded that there was “little auditory or taste

evidence to alert patients when they have used the number of doses that the [pMDIs are] designed to reliably deliver.” Fink 2005, CIPLA-BDI\_0784184, at -189.

49. Further, at the time, the only FDA-approved approach to keep track of the number of remaining doses in a canister was for patients to maintain a running, written tally of the doses used. *See, e.g.*, Sander 2006, TEVADOC-00000046, at -49-50. However, this method “is inconvenient, impractical, [and] unrealistic,” as “[m]ost patients do not keep a running tally of the doses used.” Fink 2005, CIPLA-BDI\_0784184, at -189; *see also* Sander 2006, TEVADOC-00000046, at -50 (describing this method as a “demanding” practice that was “cumbersome” and “impractical”); Fink 2005, CIPLA-BDI\_0784184, at -188 (“[D]etermining the doses remaining in a pMDI canister is beyond the technical means of most patients, unless they are *extremely disciplined* in recording device-use . . .”) (emphasis added); ’289 Patent at 1:49-54 (“A drawback of self-administration from an inhaler is that it is difficult to determine how much active drug and/or propellant are left in the inhaler, if any . . .”); Carr Dep. Tr. 16:12-21 (“Q. And if you didn’t have a dose counter, I think it would be easy to lose track of how many doses are remaining in the canister. Would you agree with that? A. If I didn’t have a dose counter, I’d have to put it in calendar in my phone because, otherwise, I would not remember, or I’d have to start at the beginning of the month, or something like that to guide me. Off the top of your head, it would be easy to lose track.”).

50. Without a reliable dose counting method, patients had to “guess how many doses [we]re left in their [p]MDIs.” FDA Guidance 2003, TEVAQVAR-00032573, at -577. In the absence of a dose counter, patients sometimes “throw away a[ p]MDI that may still contain acceptable metered-doses” leading to “waste[].” *Id.*; Holt 2005, at 106 (“These findings confirm that patients are unable to determine when a[ p]MDI should be discarded, resulting in . . .

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wastage of the drug . . . ."); Sander 2006, TEVADOC-00000046, at -50 (noting that "refill rates are much higher than they should be" for some patients). More troubling still, in the absence of a dose counter, patients sometimes "use a product when it may be beyond the recommended number of doses and risk not receiving the correct drug dose" resulting in potentially life-threatening situations and increased hospitalizations. *See* FDA Guidance 2003, TEVAQVAR-00032573, at -577; Holt 2005, at 106 ("These findings confirm that patients are unable to determine when a[ p]MDI should be discarded, resulting in insufficient drug delivery at the end of the life of a[ p]MDI for the majority of patients . . . ."); Sander 2006, TEVADOC-00000046, at -50 ("It is wholly unacceptable that so many patients, believing they are equipped with the means to manage their asthma and life-threatening episodes, are actually using an empty inhaler and putting their lives at risk simply because they do not know whether their inhaler contains medication and have no way of making that determination."); Ogren 1995, TEVADOC-00000011, at -14-15 ("We believe the combination of using an inaccurate technique for determining when to replace a metered-dose inhaler and the large number of actuations that may remain beyond the number of listed by a manufacturer clearly means that many asthmatic patients are utilizing actuations that may not contain accurate doses of medications. . . . The implications . . . are worrisome [and] potentially serious . . . ."); Fink 2005, CIPLA-BDI\_0784184, at -189 (deeming "absence of a dose-counting mechanism" a "serious limitation that commonly places patients at risk" as patients may "receive[] less than the required threshold dose"); Hess 2008, at 710 (noting that, in one study, "25% [of patients] reported having found their pMDI empty during an asthma exacerbation (several of those patients had to call 911), and 82% of them considered their pMDI empty when absolutely nothing came out"); '289 Patent at 1:49-54 (stating that difficulty in "determin[ing] how much active drug and/or propellant are left

in an inhaler, if any" is "potentially hazardous for the user since dosing becomes unreliable and backup devices not always available"); Carr Dep. Tr. 17:2-14 ("Q. . . . And if you lose track of how many dose counters are left, that's bad because, perhaps, you might throw the canister away when you really – when there's still medicament in the canister, right? A. Yes, or you could use it past the point of where it kept working, so – and then you would notice because you weren't feeling as well. Q. Right. So I believe if you use too much – or if you have the canister and you think you still have doses, but you actually don't, that could be dangerous for a patient, right? A. It can be.").

51. In my experience treating patients with asthma and COPD, I frequently observed the problems that resulted from the lack of a reliable and/or accurate dose counter. By way of background, a medicament canister will still continue spraying beyond the point where it runs out of the active drug. As a result, a patient may think that he or she has remaining doses in a canister simply because the inhaler sprays after an actuation. I treated several patients who, lacking a reliable and accurate dose counter, would often continue using their inhalers simply because the inhaler released a spray even if there was no longer any medication in the spray. The additional number of sprays without medication is one reason why several of the techniques outlined above are ineffective at determining the number of doses remaining in a canister. For example, floating a canister *might* reveal how many sprays are remaining in a canister, but floating a canister will not reveal how many sprays *with active drug* are remaining in a canister. The taste test likewise does not accurately reveal to a patient how much medication is remaining in a canister. Moreover, requiring a patient to keep track of (in writing) of how many doses remain in a canister is a formidable task. In fact, in over 30 years of treating patients, I have not

treated a patient who was able to reliably keep track of how many doses were remained in a canister over an extended period of time.

52. In my experience, the inability to accurately measure how much active drug remains in a canister could lead to a medical emergency or lead to waste. Several patients, for example, would replace their medicament canisters before it was necessary to do so and discarded medicament canisters that still contained medication. Other patients would continue using their inhalers even though the medicament canisters did not contain any medication. If these patients were prescribed a maintenance medicine (i.e., beta antagonists) to treat asthma, they would have to resort to rescue therapies more often because they were not receiving sufficient maintenance medicine. Accurate and reliable dose counters, such as those in Qvar® HFA with dose counter and ProAir® HFA with dose counters, were critical in addressing these issues.

53. Given these concerns, several commentators “recommended that all pMDIs be equipped with dose counters or indicators,” and stated that integrating dose counters in the actuator would achieve two goals: (1) “improv[ing] the cost-effectiveness of asthma management by regulating refill rates and reducing hospital visits”; and (2) ensur[ing] that patients hav[e] medication on hand when they need it, thereby granting them the security inherent in reliable disease management.” Sander 2006, TEVADOC-00000046, at -49-50; see also Holt 2005, at 106 (reporting that studies supported integrated dose-counting devices in pMDI products); Broeders 2009, TEVADOC-00000001, at -03 (stating that it is disadvantageous for pMDI to lack dose counter “to assess remaining doses”).

54. Indeed, in my experience, one of the important reasons to include a dose counter in an inhaler is so that physicians like myself can ensure that patients are complying with their

recommended dosing regimen. For example, if a patient returns for a follow-up visit with me and brings his or her inhaler, I would review the dose counter. Maintenance inhaler use such as Qvar® should be used two actuations twice daily. If the counter revealed less than the expected use then I would be alerted that the patient has been non-adherent to their prescribed therapy. Additionally, if their rescue inhaler use (ProAir®) was higher than expected (2 puffs weekly) then these data would suggest the patient's asthma or COPD is under poor control. In both hypothetical situations, I, the prescriber, would alter therapy.

55. The FDA published guidance recommending integration of dose-counting mechanisms into pMDI drug products in 2003. See FDA Guidance, TEVAQVAR-00032573. Among other things, the FDA made the following recommendations:

- Dose counters should provide . . . a clear indication of when a[ p]MDI is approaching the end of its recommended number of actuations as well as when it has reached or exceeded that number.
- An indication that a[ p]MDI is approaching the end of its recommended number of actuations should occur when a sufficient number of actuations are left to give patients enough time to obtain a new [p]MDI.
- If a numeric count is chosen, [the FDA] recommend[s] that the counter be designed so that it counts downward from the recommended number of actuations to zero, rather than counting upwards, enabling patients to know when a device is approaching the end of its life (i.e., the number of actuations is approaching zero).
- Dose counters should be engineered to reliably track actuations and should be designed to be as close to 100 percent reliable as possible.
- [I]f some low frequency of error is unavoidable, the device should be designed to specifically avoid undercounting (i.e., the [p]MDI sprays, but the counter does not advance). Undercounting could result in patients assuming they have medication left in their [p]MDI when they do not, a circumstance that is potentially dangerous.
- The reliability of dose counters should be established during development under in-vitro testing (simulating use and potential abuse), as well as in clinical use.

- [These studies] should address issues related to ergonomics, ruggedness, and accuracy of the counters in clinical settings.

FDA Guidance 2003, TEVAQVAR-00032573, at -578-79.

56. Defendants' documents acknowledge that the FDA Guidance addressed several problems with devices that were on the market as of the priority dates. *See, e.g., CIPLA-BDI\_0783819* ("Cipla Dose Counters" Deck) at *CIPLA-BDI\_0783823-27* (setting out recommendations in FDA Guidance) and at *CIPLA-BDI\_0783843*, *CIPLA-BDI\_0783845* (recognizing problems with prior art, including lack of "reliable method by which a patient could determine whether any drug remained in their [p]MDI").

57. In response to the FDA guidance, many companies worked on developing counting mechanisms. However, many early dose counting mechanisms had shortcomings. In particular, the prior art recognized problems with achieving accurate counting over the life of the inhaler. *See, e.g., '021 Publication, ¶ [0006]* (stating that indicating devices with "complex moving parts" may be "susceptible to counting inaccuracies due to the configuration of the indexing or mating parts"); *Hess 2008*, at 711 (noting that some devices "occasionally recorded additional actuations," and that, "[o]ver time," showed a "trend toward decreasing accuracy"); *id.* (noting that some devices did not "record[] actuations after the preset counter reaches zero, which leads to premature arrival of the counter at zero and subsequent inability to record further doses"); *id.* (noting that some devices showed a trend in decreasing accuracy as a result of "battery decay").

58. In my experience, prior art devices were not precise in conveying dosage information to a patient. Many did not provide the exact number of doses remaining, but merely provided a patient with a general idea of how many doses were remaining in a medicament

canister. Several patients who relied on imprecise dose indicators had to guess how many doses remained in a medicament canister. In addition, prior art devices in my experience were not sleek in their design. Instead, they were clunky or bulky because the counting mechanism would sit on the flat bottom of the canister and/or extend outside the inhaler body. From an ergonomic perspective, this made it more difficult for patients to actuate the device. As a result, many of these patients would be less likely to use the inhaler on a consistent basis. Moreover, when the counting mechanism was an add-on device, patients would often remove the add-on device in order to fit the inhaler in their pockets. This, in turn, created a number of other issues. For example, patients would lose the add-on devices and thereby would lose track of the number of doses remaining in a canister. By way of further example, a patient would also tamper and damage the add-on device, rendering them unreliable.

59. Because prior art dose counters suffered from shortcomings, there remained a long-felt, unmet need for inhalers with improved dose counters. The Asserted Patents note the problems associated with then-existing dose counters, the need for improvement, and the difficulty of solving the problem given variability in patient use. *See, e.g.*, '289 Patent, 2:6-8 (“[S]ome dose counters do not keep a particularly reliable count, such as if they are dropped onto a hard surface.”); *id.*, 2:9-12 (“More recently, it has become desirable to improve dose counters further and, in particular, it is felt that it would be useful to provide extremely accurate dose counters for manually-operated canister-type metered dose inhalers.”); *id.*, 2:13-31 (“[I]t has been found . . . that the stroke length of the canister is to a very large extent controlled on each dose operation by the user, and by hand. Therefore, the stroke length is highly variable and it is found to be extremely difficult to provide a highly reliable dose counter [that could lead to over-and/or under-counting].”).

60. Moreover, the prior art recognized that there was a long-felt, unmet need for inhalers with dose counters that had the functionality and minimal impact on device performance of the claimed inventions. *See, e.g.*, '021 Publication, ¶ [0006] (noting that some indicating devices “may impede or interfere with the airflow and medicament being dispensed from the inhalation device”); *id.* (noting that some indicating devices may “require a power source” in order to function).

61. Moreover, the prior art recognized that there was a long-felt, unmet need for inhalers with dose counters that had the manufacturability of the claimed inventions. *See, e.g.*, *id.* (stating that indicating devices “may include complex moving parts which can be difficult to assemble and expensive to manufacture”). This long-felt, unmet need for inhalers with dose counters that had manufacturability was part of the motivation for the Asserted Patents. *See, e.g.*, '289 Patent, 2:31-33 (“It has also been found to be fairly difficult to assembl[e] some known inhaler devices and the dose counters therefor.”).

62. Moreover, the prior art recognized that there was a long-felt, unmet need for inhalers with dose counters that had the aesthetics and/or ergonomics, and/or met other human factors of the claimed inventions. In other words, there was a long-felt, unmet need for inhalers with dose counters that did not add bulk to or otherwise change the appearance of the inhalers with which patients were already familiar, and that did not change the manner in which patients used their inhalers. *See, e.g.*, '021 Publication, ¶ [0006] (noting that indicating devices with “complex moving parts” may “require excessive amounts of space within the housing to accommodate the relatively large or numerous moving parts”); Williams 1999, at 1499 (noting that when patients hold some devices, the distance “between the thumb and forefinger” “may be too far for some patients to actuate comfortably,” and that this “may be difficult, especially for

arthritic patients, children, or other persons with small hands"); Hess 2008, at 711 (explaining that add-on electronic counting mechanisms "add to the cost" and "complexity of therapy because they add a device to the treatment regimen"); Fink 2005, CIPLA-BDI\_0784184, at -189 (explaining that "[t]hird-party counting devices are available, but add additional expense").

63. Moreover, the prior art recognized that there was a long-felt, unmet need for inhalers with dose counters that were easily maintainable and could be cleaned, as is true of the claimed inventions. *See, e.g.*, '298 Patent, 2:33-35 ("Additionally, it is felt desirable to improve upon inhalers by making them easily usable after they have been washed with water"); '021 Publication, ¶ [0006] (noting that some indicating devices "may be susceptible to damage in various environments, such as moist conditions").

**2. Prior-Art Solutions Failed to Satisfy the Need for Devices with the Properties of the Claimed Inventions.**

64. Although various solutions had been proposed to satisfy these needs, as of the priority dates, none of them succeeded in doing so. I summarize examples of those solutions below.

**a. Prior Art Devices and Disclosures Related to Imprecise Dose Indicators.**

65. By way of example, many prior art devices or disclosures related not to dose counters, but rather to imprecise dose indicators, including devices disclosed or in development by Valois Pharma/Aptar, AstraZeneca, Trudell Medical International ("Trudell"), Senetics, Inc. ("Senetics"), Sapphire Designs, Inc. ("Sapphire"), Bespak, plc ("Bespak"), among others.

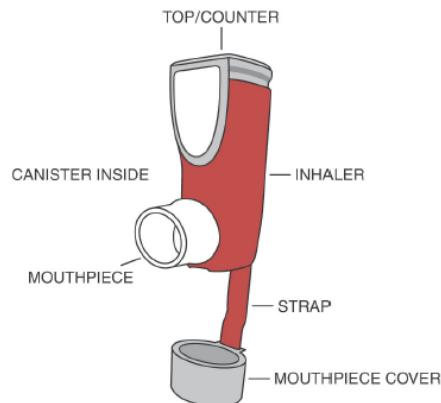


Figure 1



See Symbicort® Prior Approval Supplement 2007, Medication Guide 8, 12.

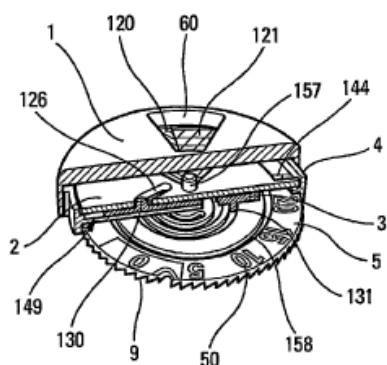


Fig. 4

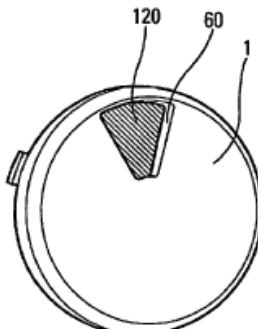


Fig. 5

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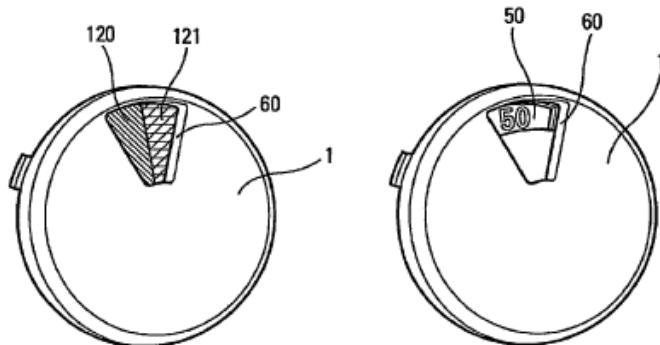
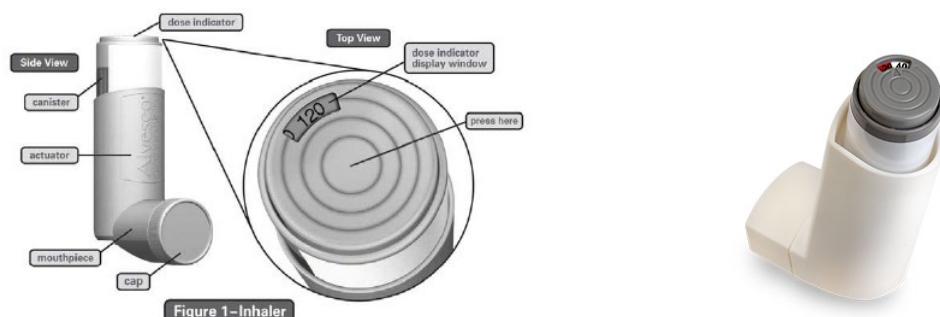


Fig. 6

Fig. 7

Valois S.A.S. – U.S. Patent No. 7,637,227, Figs. 4-7, 3:67-4:1 (depicting dose indicator marked in intervals of five, and dose indicator that “can be of different colors”).



See Trudell – Alvesco® Labeling 2008, at 22; <https://www.trudellmed.com/aerocount-dose-counter> (“Trudell AeroCount Dose Counter”).

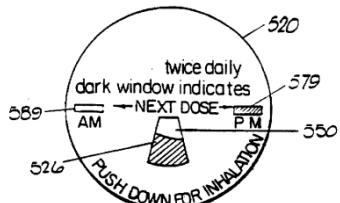


FIG. 14

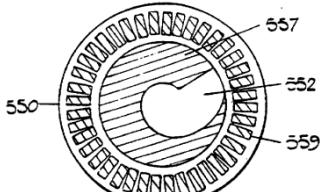
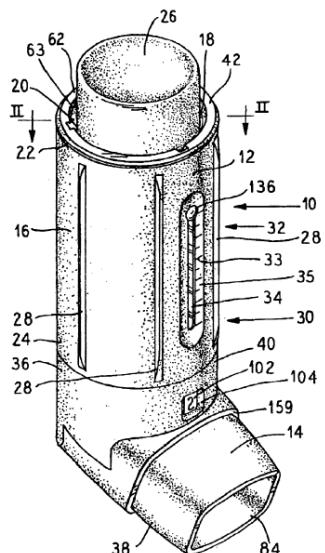


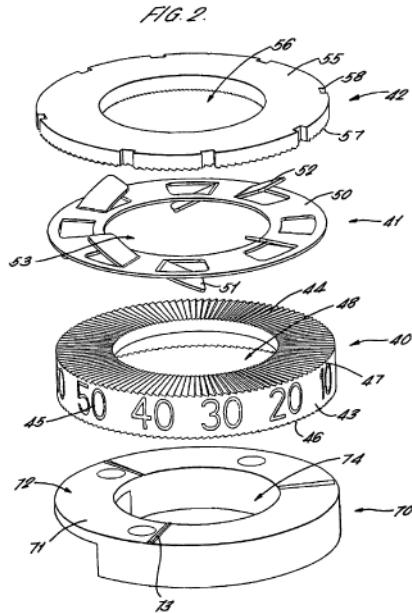
FIG. 15

See Senetics – U.S. Patent No. 5,718,355, Figs. 14, 15, 26:47-27:34 (disclosing dose indicator “system to remind the user to dispense medication at set intervals”).

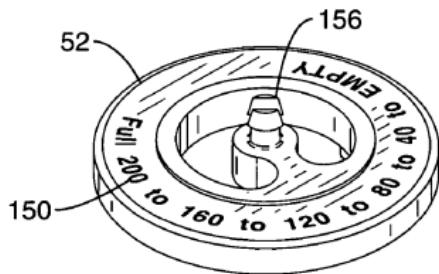
FIG. 1



See Sapphire – U.S. Patent No. 6,615,827, Fig. 1, 16:18-20 (disclosing pointer 136 that slides in a slot and is “indicative of the amount of medicament remaining in the medicament dispenser”).



See Bespak – U.S. Patent No. 7,407,066, Fig. 2, 2:49-62 (indicator wheel marked in ten-dose intervals).



**FIG. 11A**

See Cipla – U.S. Patent No. 7,600,512, Fig. 11A (disclosing indicator with range of remaining doses in actuator); *see also* Assignment Records for U.S. Patent No. 7,600,512.

66. It is my opinion that these and other, similar prior art devices and disclosures did not meet the need in the art for an accurate, precise dose counter, because they did not report to patients the precise number of doses remaining in their inhalers. Instead, these and other dose indicators provided an indication of whether the canister was near full, near empty, or somewhere in-between, or else provided more general information about the number of uses that

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had occurred. *See, e.g.*, Stuart 2013, at 40 (“[Dose indicators] often do not index every count and require some patient interpretation of the display. . . . [Dose indicators] are not considered by patients to be as accurate as dose counters.”); Conner 2013, at 661 (“Dose indicators that rely solely on a color coded display or indicator symbol . . . are less precise than dose counters that use a numeric display . . .”). The Asserted Patents reflect a desire to improve upon such dose indicating devices in prior art by providing “extremely accurate dose counters.” ’289 Patent, 2:9-12.

67. Dose indicators do not satisfy the need for accurate, precise dose counters and are inferior because they do not allow as much planning for patients to replace their medicament canisters as precise, accurate dose counters do. Consequently, patients using inhalers with dose indicators had to estimate the number of uses remaining, risking under- or over-estimation. *See, e.g.*, Stuart 2013, at 40-41. Estimating the number of uses remaining could lead to patients doing two things: (1) “throw[ing] away a[ p]MDI that may still contain acceptable metered-doses,” thereby leading to waste; or (2) “us[ing] a product when it may be beyond recommend number of doses and risk not receiving the correct drug use.” FDA Guidance 2003, TEVAQVAR-00032573, at -577; *see also, e.g.*, Holt 2005, at 106; Sander 2006, TEVADOC-00000046, at -49-50; Ogren 1995, TEVADOC-00000011, at -14-15; Fink 2005, CIPLA-BDI\_0784184, at -189; Hess 2008, at 710.

68. As I discuss above, in my experience, dose indicators did not precisely convey the number of remaining doses to a patient. In the absence of such information, a patient would need to guess the number of remaining doses in a canister. Moreover, the devices that relied on dose indicators that had various colors were not effective for patients who were color blind. In my experience treating patients, a significant number of males are color blind. And color-blind

patients stated that it was difficult for them to discern the colors on the dose indicators and to read the font sizes of those prior art devices. Conversely, Qvar® HFA with dose counter and ProAir® HFA with dose counter were much more effective for these color-blind patients. The dose counters in these devices did not rely on dose counters and the font size was much easier for patients to discern.

**b. Prior Art Devices and Disclosures Attached to the Canister or Extending Beyond the Inhaler Body.**

69. By way of further example, in many prior art devices or disclosures, the dose counter or dose indicator was not internal to the device, but instead extended outside the inhaler body. *See, e.g., CIPLA-BDI\_0783819 (“Cipla Dose Counters” Deck) at CIPLA-BDI\_0783828-30* (acknowledging that dose counters or dose indicators could be “fixed on the valve” or “fixed on the can bottom”). This included devices disclosed or in development by AstraZeneca, Trudell Medical, Valois Pharma/Aptar, and Senetics, among others.

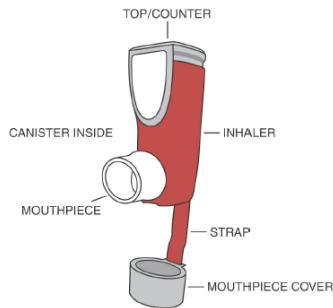
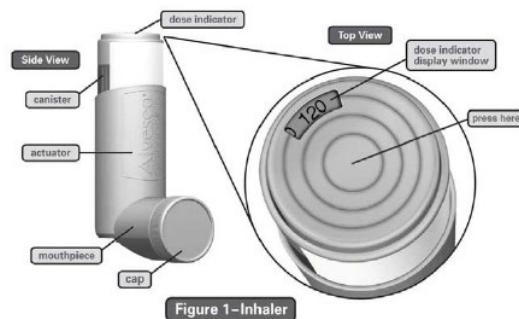


Figure 1

*See Symbicort® Prior Approval Supplement 2007, Medication Guide 8 (depicting dose counter situated on flat bottom of canister and outside and on top of device).*



See Alvesco® Labeling 2008, 22 (depicting dose counter situated on bottom of canister and outside and on top of device); Trudell AeroCount Dose Counter (same).

FIG. 1A

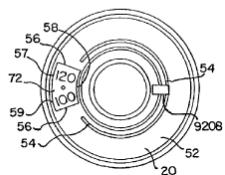


FIG. 2

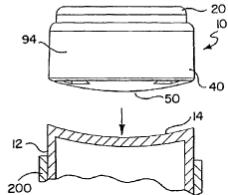
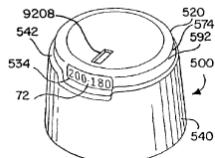
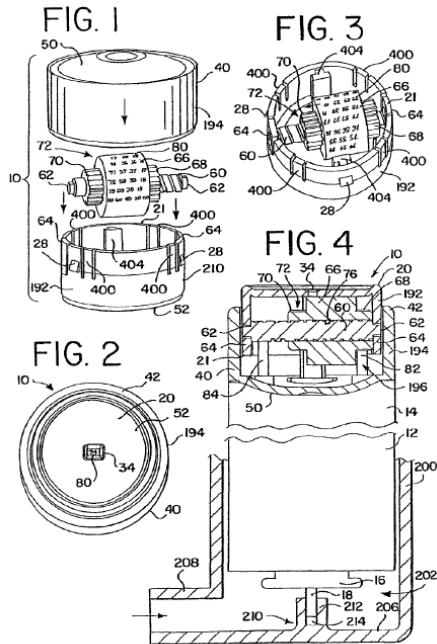


FIG. 3A



See Trudell – U.S. Patent No. 8,578,934, Figs. 1-2, 3:30-31 (“indicating device” mounted to bottom of canister and on top and outside of device).



See Trudell – U.S. Patent No. 8,869,735, Figs. 1-4, 5:58-65 (indicating device is mounted to flat bottom of canister and sits on top and outside of device).

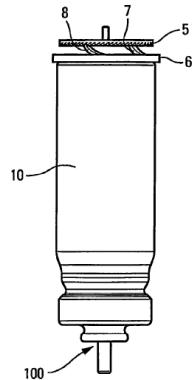


Fig. 8

See Valois – '227 Patent, Fig. 8 (disclosing embodiment in which dose indicator is mounted on bottom of canister).

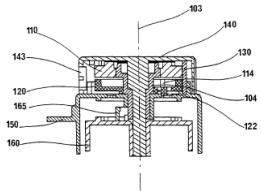


FIG.6

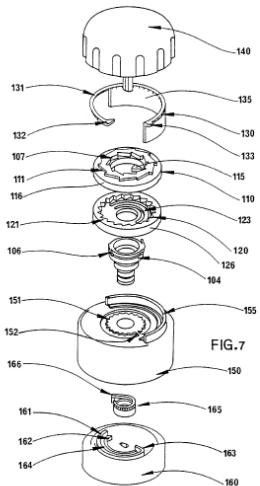


FIG.7

See Valois – U.S. Patent No. 5,988,496, Figs. 6, 7 (appears to disclose dose indicator mounted on flat bottom of canister).

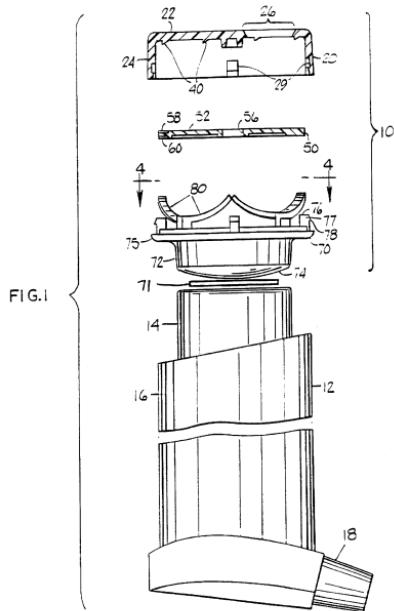


FIG.1

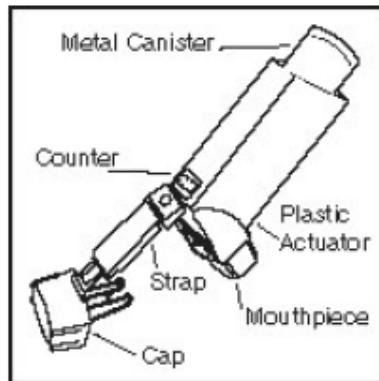
See Senetics – '355 Patent, Fig. 1, 7:35-62 (appearing to disclose embodiment in which dose indicator is mounted on flat bottom of canister).

70. When counting mechanisms are attached to the flat bottom of the canister and are therefore situated near or on top of the actuator, the counting mechanism is exposed to the patient. As such, it is susceptible to tampering and abuse, and could become less reliable if the inhalation device is dropped. *See, e.g.*, Stuart 2013, at 41 (identifying as disadvantage “the fact that the counter itself is exposed to the patient, which therefore means it must be designed to withstand a higher level of tampering and abuse”); *see also* ’289 Patent, 2:6-8 (“[S]ome dose counters do not keep a particularly reliable count, such as if they are dropped onto a hard surface.”).

71. As these diagrams show, the addition of the dose counter or dose indicator also increases the overall size of those devices, reducing their aesthetic and ergonomic value. In my experience as a prescribing physician, and consistent with the observation of some commentators, top-mounted dose counters may create a longer distance “between the thumb and the forefinger” that “may be too far for some patients to actuate comfortably.” Williams 1999, at 1499; *see also* ’021 Publication, ¶ [0006] (noting drawback of indicating device that may require “excessive amounts of space”). This could be especially “difficult” for “arthritic patients, children, or other persons with small hands.” Williams 1999, at 1499; Stuart 2013, at 41 (describing as disadvantage top-mounted dose counters or indicators because “overall height” of device “is extended and has the potential to create difficulty for patients with a limited hand span”); Kennedy 2015, at 4 (“The introduction of externally mounted dose counters or indicators can require significant changes to the actuator’s external dimensions, resulting in a bulky profile. A top mounted dose counter or indicator extends the hand span required for operation.”). In my experience as a prescribing physician, patients are less likely to adhere to their medication

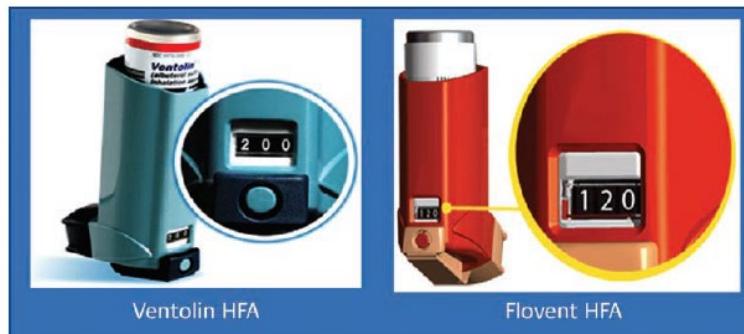
regimen if a counting mechanism reduces the aesthetic and/or ergonomic value and comfort of their device.

72. Even when internal dose counters were contemplated, attachment to the medication canister near the valve was a common approach to avoiding the problems solved by the claimed invention.



**Figure 1**

See GlaxoSmithKline – ADVAIR® HFA Prescribing Information at 41 (Sept. 15, 2009) (“Each canister is fitted with a counter . . . ”).



See Ari 2009, at 31 (“The Ventolin® HFA ([GSK], Research Triangle Park, NC) and Flovent® HFA ([GSK]) have built-in dose counters . . . ”).

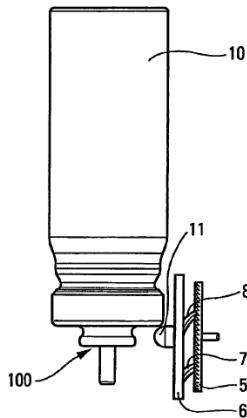
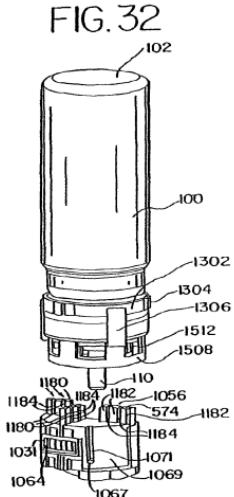


Fig. 9

See Valois – '227 Patent, Fig. 9, 3:46-47 (disclosing embodiment in which dose indicator is fixed to “the side” of “reservoir”).



See Trudell – U.S. Patent No. 8,157,128, Fig. 32 (disclosing “indicating device” fixed to canister).

73. In my experience as a prescribing physician, counting mechanisms that are fixed near the valve of the canister increase the bulkiness of the device near the boot of the actuator and may affect airflow. See, e.g., '021 Publication, ¶ [0006] (noting that some indicating devices “may impede or interfere with the airflow and medicament being dispensed from the inhalation device”). In addition, the added bulkiness increases the difficulty for a patient to actuate the device, especially for arthritic patients, children, or other persons with small hands. See, e.g.,

Stuart 2013, at 41 (noting that side-mounted dose counters have “bulky appearance and size, which patients may find ungainly to use” and that “addition of a side-mounted dose counter to an existing product can drastically change its appearance, which can have a negative impact on a product where maintaining patient familiarity is essential”).

74. Ultimately, patients may not receive adequate inhalation medication if they are using a device with a counting mechanism that affects airflow. Moreover, patients are less likely to adhere to the medication regimen if the dose counter in their inhaler reduces the aesthetic and/or ergonomic value of the device or otherwise makes it less convenient to carry and use.

**c. Prior Art Devices and Disclosures Related to Electronic Components That Had Limited Functionality, Reliability, Manufacturability, and Ergonomic Value.**

75. By way of further example, many dose counters contained complicated electronic components and consequently, were useful only for very limited purposes and/or had limited reliability, manufacturability, and/or ergonomic value. Several of the dose counters containing complicated electronic components were disclosed or in development by Valois Pharma/Aptar, Nexus6, MediTrack Products, and Respirics, Inc. (“Respirics”), among others.

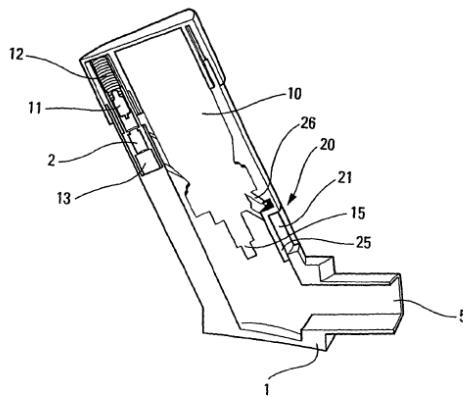
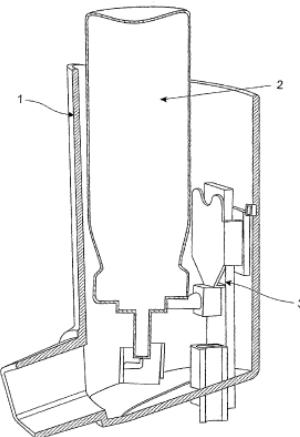


Fig. 3

See Valois – U.S. Patent No. 8,267,086, Fig. 3, Abstract (disclosing device “including a dose indicator having an electronic display”).

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**FIGURE 1**

*See Nexus6 Limited – U.S. Patent App. No. 2008/0230057, ¶ [0067] (disclosing device that can activate “audio output device caus[ing] an audible signal to be issued by the system to remind the user to take a dose of their medicament”).*



*See MediTrack Products – The Doser; Hess 2008, at 710-11 (describing Doser as electronic add-on device that can count down number of remaining doses in canister).*



*See Respirics – MD Turbo™; Hess 2008, at 711 (device is electronic dose counter); Lewis 2007, CIPLA-BDI\_0184747, at -750; Ari 2009, at 26.*

76. These electronic devices and disclosures present several drawbacks. For example, the Doser and MD Turbo™ devices are not “integrated” and are simply an add-on, *see* Hess 2008, at 710-11 (Turbo); Lewis 2007, CIPLA-BDI\_0184747, at -750 (MD Turbo™), which presents problems for patients. “[T]he use of an add-on device undermines the portability advantages of the [p]MDI” and makes the device “bulk[y]” which “may result in non-compliance in patient use.” Lewis 2007, CIPLA-BDI\_0184747, at -749-50.

77. The device disclosed by Nexus6 also does not even count the number of doses remaining in a canister. *See generally* '057 Publication. Instead, the Nexus6 disclosure relates to an alarm clock that reminds patients when it is time for them to take their medication. *See id.* Nexus6’s disclosure does not include a dose counter that provides “a clear indication of when a[ p]MDI is approaching the end of its recommended number of actuations as well as when it has reached or exceeded that number.” FDA Guidance 2003, TEVAQVAR-00032573, at -578.

78. The prior art also cast doubt on the reliability of electronic mechanisms. *See, e.g.*, '021 Publication ¶ [0006] (stating that devices with “electrical circuitry” “may be susceptible to damage in various environments, such as moist conditions”). Further, one study showed that the Doser “occasionally recorded additional actuations. Over time, there was a trend toward decreasing accuracy with the Doser, which may be explained by battery decay.” Hess 2008, at 711. That study also found that “the Doser no longer records actuations after the preset counter reaches zero, which leads to premature arrival of the counter at zero and subsequent inability to record further doses.” *Id.*

79. Multiple commentators have noted that electronic add-on devices “add to the cost of therapy” and that “they increase the complexity of therapy because they add a device to the treatment regimen.” *Id.*; Fink 2005, CIPLA-BDI\_0784184, at -189 (“Third party dose counting devices are available, but add additional expense . . . ”). In my practice, I did not regularly prescribe electronic devices or add-on devices because they were and continue to be too expensive for patients. Insurance companies generally do not cover the cost of these devices, making them cost prohibitive for most patients. In addition, some add-on devices suffered from the problems that I outlined above. For example, the add-on device would make an inhaler too bulky for a patient to carry in his or her pocket and/or purse. So patients would regularly remove the add-on device. That, in turn, lead to instances in which the patient would lose the device and therefore lose track of the number of doses remaining in a canister.

80. Additionally, add-on devices like the Doser may reduce a device’s ergonomic value. One commentator stated that “[w]hen holding the Doser-MDI combination between the thumb and forefinger, the distance may be too far for some patients to actuate comfortably. This may be difficult, especially for arthritic patients, children, or other persons with small hands.”

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Williams 1999, at 1499. In my experience, several patients complained about the bulkiness of an inhaler body with an add-on device. Among other things, they indicated that the combination of the inhaler with an add-on device made it more difficult to actuate the device.

81. Moreover, devices with electrical circuitry “can be relatively expensive to manufacture.” ’021 Publication ¶ [0006]. In my experience, insurance companies would typically not cover the cost of these kinds of electronic devices. Most of my patients did not want or could not afford to pay for expensive inhalers. In my experience, these kinds of devices were cost prohibitive.

82. In my experience as a prescribing physician, patients are less likely to adhere to a medication regimen when there are features on their inhalation devices that reduce ergonomic and/or aesthetic value, increase the cost of therapy, and/or render the devices less reliable with time.

### **3. Qvar® HFA and ProAir® HFA Satisfied Long-Felt Needs**

83. The non-obviousness of the claimed inventions as embodied in Qvar® HFA with dose counter and ProAir® with dose counter is evidenced by the fact that they satisfied multiple, long-felt, unmet needs for dose counters in metered dose inhalers.

84. Unlike prior art devices, including the devices discussed above, Qvar® HFA with dose counter and ProAir® with dose counter include dose counters with sufficient functionality, accuracy (including, with respect to under- and over-counting), reliability and/or robustness.

*See, e.g., Carr Dep. Tr. 15:21-16:4 (“Q. Okay. And that Qvar device has a dose counter, right?*

A. Yes. Q. And would you say that it was easy to see how many doses were remaining in your device? A. Yes. Q. Did you think the dose counter in the Qvar device is reliable? A. Yes, as a patient.”); Given 2012, TEVADOC-00000010, at -10 (“ProAir HFA [p]MDI with the new integrated dose counter functioned reliably and accurately in the clinical setting.”); Chipps 2017,

TEVADOC-00000008, at -08 (“In patients with asthma and/or COPD, albuterol inhalation aerosol (ProAir HFA) with dose counter, compared with the same product without dose counter, had significantly lower healthcare resource use including all-cause and respiratory-related inpatient [emergency department] visits, higher refill rates, and fewer exacerbations.”); Kerwin 2017, at 1 (“In a real-world setting, asthma patients using ProAir HFA with [dose counter] experienced significantly fewer hospitalizations and [emergency department] visits compared with patients using ProAir HFA without [dose counter.]”).

85. For example, Qvar® HFA with dose counter and ProAir® HFA with dose counter included precise dose counters as opposed to imprecise dose indicators that merely provided an indication of whether the canister was near full, near empty, or somewhere in-between, or else provided more general information about the number of uses that had occurred. As a result, the dose counters included in Qvar® HFA with dose counter and ProAir® HFA with dose counter provided patients with more time to plan to replace their medicament canisters. Consequently, patients who used Qvar® HFA with dose counter and ProAir® HFA with dose counter did not have to estimate the number of uses remaining, risking under- or over-estimation.

86. By way of further example, unlike devices in the prior art, Qvar® HFA with dose counter and ProAir® HFA with dose counter included dose counters that did not rely on color coding. As a result, color-blind patients did not have difficulty relying on the dose counters included in Qvar® HFA with dose counter and ProAir® HFA with dose counter.

87. By way of further example, unlike devices in the prior art, Qvar® HFA with dose counter and ProAir® HFA with dose counter did not include counting mechanisms that were attached to the flat bottom of the canister and/or extended outside the body. As a result, the dose counters included in Qvar® HFA with dose counter and ProAir® HFA with dose counter are not

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exposed to the patient and are less susceptible to tampering and abuse. Moreover, unlike devices in the prior art, the dose counters included with Qvar® HFA with dose counter and ProAir® HFA with dose counter do not become less reliable if the inhalation device is dropped.

88. Further, unlike prior art devices, including the devices discussed above, Qvar® HFA with dose counter and ProAir® with dose counter include dose counters with sufficient functionality. *See, e.g.*, Carr Dep. Tr. 14:16-23 (“Q. And what did you like about the original Qvar[® with dose counter] device? A. It worked. It didn’t clog. You could store it any way and it always worked when you needed it. Q. And so would you say that the Qvar[® with dose counter] device was easy to operate? A. Yes.”); Given 2012, TEVADOC-00000010, at -10 (“ProAir HFA [p]MDI with the new integrated dose counter functioned reliably and accurately in the clinical setting.”).

89. For example, unlike devices in the prior art in which the counting mechanism was fixed near the valve of the canister, the dose counters included in Qvar® HFA with dose counter and ProAir® HFA with dose counter did not affect the airflow of the device. As such, patients who used Qvar® HFA with dose counter and ProAir® HFA with dose counter received an adequate amount of inhalation medication.

90. Further, unlike prior art devices, including the devices discussed above, Qvar® HFA with dose counter and ProAir® with dose counter include dose counters with sufficient maintainability (and ability to be cleaned). *See, e.g.*, Carr Dep. Tr. 15:16-20 (“Q. . . . And would you say that it was easy to wipe it down and to generally just maintain the Qvar device? A. I never did. I just used it, and *it didn’t clog, even without cleaning*” (emphasis added)).

91. Unlike prior art devices, including the devices discussed above, Qvar® HFA with dose counter and ProAir® with dose counter included dose counters that had minimal impact on

the performance of the inhalation device. *See, e.g.*, Carr Dep. Tr. 14:12-14 (patient stating that she “liked” Qvar® HFA with dose counter), 14:16-15:3 (“Q. And what did you like about the original Qvar[® with dose counter] device? A. It worked. It didn’t clog. You could store it any way and it always worked when you needed it. Q. And would you say that the Qvar[® with dose counter] device was easy to operate? A. Yes. Q. Do you also think that the Qvar[® with dose counter] device fit comfortably in your hand when you were using it? A. It took a bit to adjust to firing it as a patient versus in the lab. But yes, it became comfortable.”).

92. For example, unlike devices in the prior art, Qvar® HFA with dose counter and ProAir® with dose counter did not include electrical circuitry that made the devices more susceptible to damage in various environments, such as moist conditions.

93. Further, unlike prior art devices, including the devices discussed above, Qvar® HFA with dose counter and ProAir® with dose counter include dose counters that satisfied a variety of human factors (including aesthetics, ergonomics, and other human factors). *See, e.g.*, Carr Dep. Tr. 14:12-14 (patient stating that she “liked” Qvar® HFA with dose counter), 14:16-15:3 (“Q. And what did you like about the original Qvar[® with dose counter] device? A. It worked. It didn’t clog. You could store it any way and it always worked when you needed it. Q. And would you say that the Qvar[® with dose counter] device was easy to operate? A. Yes. Q. Do you also think that the Qvar[® with dose counter] device fit comfortably in your hand when you were using it? A. It took a bit to adjust to firing it as a patient versus in the lab. But yes, it became comfortable.”).

94. For example, unlike devices in the prior art, the dose counters included in Qvar® HFA with dose counter and ProAir® HFA with dose counter did not increase the overall size of the inhaler device because the dose counters were not attached to the flat bottom of the canister.

Moreover, unlike devices in the prior art, the dose counters included in Qvar® HFA with dose counter and ProAir® HFA with dose counter are not attached to the medicament canister rendering the devices bulky. Moreover, unlike devices in the prior art, the dose counter included in Qvar® HFA with dose counter and ProAir® HFA with dose counter were not add-on devices that increased the overall size of the inhaler device. As a result, the dose counters included in Qvar® HFA with dose counter and ProAir® HFA with dose counter did not reduce the aesthetic and ergonomic value of the device.

95. Moreover, unlike devices in the prior art, Qvar® HFA with dose counter and ProAir® HFA with dose counter were not comprised of electronic components that rendered the product cost prohibitive for most patients.

96. Thus, Qvar® HFA with dose counter and ProAir® HFA with dose counter satisfied a long-felt need in the art for inhalers with dose counters possessing the above characteristics, including combinations of two or more above the above characteristics.

#### **B. Failure of Others**

97. The nonobviousness of the Asserted Claims is further evidenced by the fact that others tried, but failed, to achieve dose counters with the desirable features explained above. Before and after the priority date, numerous companies, including Senetics, Bespak, Trudell Medical, GSK, Valois, AstraZeneca, MediTrack Products, Sapphire, Nexus 6, Cipla, *see, e.g.*, Section VI.A.2, *supra*, Newtec, Aptar, Cohero Health, Inc. (“Cohero”), and others tried, *see, e.g., infra*, but failed to achieve counting mechanisms having the claimed qualities. Among other things, such counting mechanisms were less accurate, less reliable, less robust, less compact, less ergonomic, less maintainable and/or cleanable, more difficult to manufacture and/or assemble, more expensive, more susceptible to human factors, and/or more disruptive to device performance, including by extending into the housing. *See, e.g.,* Section VI.A.2, *supra*.

98. By way of further example, Newtec markets a “front-facing end of life indication mechanism.” Newtec, Dose Counting Actuator, <http://newtecpro.com/newtec-dose-counter/>; *see generally* U.S. Patent No. 10,765,819 (assignee: Newtec Pro Manufacturing Pvt Ltd).



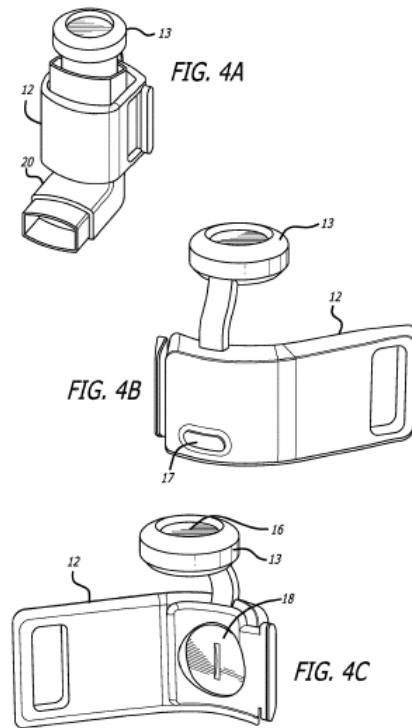
99. Similar to devices in the prior art, *see* Section VI.A.2, *supra*, Newtec’s inhalation device includes an imprecise counting mechanism. Unlike the claimed inventions, Newtec’s device provides patients with only a rough estimate of doses expended or remaining, rather than the precise count provided by the claimed inventions.

100. By way of further example, Aptar and Cohero market and/or disclose inhalers with electronic components that have limited functionality, reliability, manufacturability, and aesthetic and/or ergonomic values. *See* Section VI.A.2, *supra*.

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See Aptar, e-dose Counter, <https://www.aptar.com/products/pharmaceutical/e-dose-counter-mdis/>; see generally WO 2021/032471 A1 (Aptar Daolfzell GMBH).



See U.S. Patent No. 10,091,555 (assignee: Cohero) (disclosing electronic tracking module mounted on inhaler in Figures 4A-4C).

101. That multiple, sophisticated companies tried, but failed, to achieve the claimed inventions supports the nonobviousness of the Asserted Claims.

**C. Industry Acceptance**

102. The nonobviousness of the Asserted Claims is further evidenced by industry acceptance of the claimed inventions in the form of FDA approval. Since the priority dates, dose counters comprising the claimed combinations of components, configurations, and attachments have achieved acceptance by physicians, patients, and regulators. Such acceptance is evidenced, for example, by FDA's approval of Qvar® HFA with dose counter and ProAir® HFA with dose counter. *See, e.g.*, QVAR® Label (May 22, 2014), TEVAQVAR-00010727; ProAir® HFA Label (Mar. 7, 2012), TEVAQVAR-00066638; TEVAQVAR-00007128-TEVAQVAR-00007745.

103. In addition, I discuss and monitor the practices and preferences of other physicians in my practice and across the nation. Based on my personal experience, Qvar® HFA with dose counter and ProAir HFA® with dose counter have received praise and have been embraced by physicians (including myself) that treat patients with asthma and/or COPD, including with respect to their superior functionality, accuracy (including, with respect to over- and under-counting), reliability, maintainability (and ability to be cleaned), robustness, manufacturability, minimal impact on device performance, and human factors (including aesthetics, ergonomics, and other human factors).

104. I also discuss and monitor the practices and preferences of nurses, hospitals, and clinics in my practice and across the nation. Based on my personal experience, nurses, hospitals, and clinics that administer Qvar® HFA with dose counter and ProAir HFA® with dose counter also praise these medications and inhalation devices, including with respect to their superior functionality, accuracy (including, with respect to over- and under-counting), reliability,

maintainability (and ability to be cleaned), robustness, manufacturability, minimal impact on device performance, and human factors (including aesthetics, ergonomics, and other human factors).

105. I also discuss and monitor the preferences of patients who use Qvar® HFA with dose counter and ProAir HFA® with dose counter. Based on my personal experience, patients who use Qvar® HFA with dose counter and ProAir HFA® with dose counter also praise these medications and inhalation devices, including with respect to their superior functionality, accuracy (including, with respect to over- and under-counting), reliability, maintainability (and ability to be cleaned), robustness, manufacturability, minimal impact on device performance, and human factors (including aesthetics, ergonomics, and other human factors). *See, e.g.,* Given 2012 (“ProAir HFA [p]MDI with the new integrated dose counter functioned reliably and accurately in the clinical setting.”); Chipps 2017, TEVADOC-00000008, at -08 (“In patients with asthma and/or COPD, albuterol inhalation aerosol (ProAir HFA) with dose counter, compared with the same product without dose counter, had significantly lower healthcare resource use including all-cause and respiratory-related inpatient [emergency department] visits, higher refill rates, and fewer exacerbations.”); Kerwin 2017, at 1 (“In a real-world setting, asthma patients using ProAir HFA with [dose counter] experienced significantly fewer hospitalizations and [emergency department] visits compared with patients using ProAir HFA without [dose counter.]”); Carr Dep. Tr. 15:21-16:4 (“Q. Okay. And that Qvar device has a dose counter, right? A. Yes. Q. And would you say that it was easy to see how many doses were remaining in your device? A. Yes. Q. Did you think the dose counter in the Qvar device is reliable? A. Yes, as a patient.”), 14:16-15:3 (“Q. And what did you like about the original Qvar[® with dose counter] device? A. It worked. It didn’t clog. You could store it any way

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and it always worked when you needed it. Q. And would you say that the Qvar® with dose counter] device was easy to operate? A. Yes. Q. Do you also think that the Qvar[® with dose counter] device fit comfortably in your hand when you were using it? A. It took a bit to adjust to firing it as a patient versus in the lab. But yes, it became comfortable.”).

#### **D. Praise**

106. The nonobviousness of the Asserted Claims is further evidenced by the praise the claimed inventions have received.

107. Since their approval, Qvar® HFA with dose counter and ProAir® HFA with dose counter have received praise from physicians (including myself), patients, and regulators, including with respect to their superior functionality, accuracy (including, with respect to over-and under-counting), reliability, maintainability (and ability to be cleaned), robustness, manufacturability, minimal impact on device performance, and human factors (including aesthetics, ergonomics, and other human factors). *See, e.g.,* Section VI.C, *supra*; Given 2012, TEVADOC-00000010, at -10 (“ProAir HFA [p]MDI with the new integrated dose counter functioned reliably and accurately in the clinical setting.”); Chivell 2017, TEVADOC-00000008, at -08 (“In patients with asthma and/or COPD, albuterol inhalation aerosol (ProAir HFA) with dose counter, compared with the same product without dose counter, had significantly lower healthcare resource use including all-cause and respiratory-related inpatient [emergency department] visits, higher refill rates, and fewer exacerbations.”); Kerwin 2017, at 1 (“In a real-world setting, asthma patients using ProAir HFA with [dose counter] experienced significantly fewer hospitalizations and [emergency department] visits compared with patients using ProAir HFA without [dose counter.]”); Carr Dep. Tr. 14:12-14 (patient stating that she “liked” Qvar® HFA with dose counter), 14:16-15:3 (“Q. And what did you like about the original Qvar[® with dose counter] device? A. It worked. It didn’t clog. You could store it any way and it always

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worked when you needed it. Q. And would you say that the Qvar[® with dose counter] device was easy to operate? A. Yes. Q. Do you also think that the Qvar[® with dose counter] device fit comfortably in your hand when you were using it? A. It took a bit to adjust to firing it as a patient versus in the lab. But yes, it became comfortable.”), 15:16-20 (“Q. . . . And would you say that it was easy to wipe it down and to generally just maintain the Qvar device? A. I never did. I just used it, and *it didn’t clog, even without cleaning*” (emphasis added)).

#### E. Copying

108. The nonobviousness of the Asserted Claims is further evidenced by the fact of Aurobindo’s and Cipla’s copying. Aurobindo and Cipla chose to copy the Asserted Claims by seeking approval from FDA to market generic versions of Qvar®, which is an embodiment of the claimed inventions. As set forth in Dr. Lewis’s Opening Reports, Aurobindo and Cipla infringe the Asserted Claims. Notably, there are other marketed beclomethasone dipropionate products, but Aurobindo and Cipla chose specifically to copy Qvar®.

I declare that the foregoing is, to the best of my knowledge and belief, true and correct.

Dated: April 29, 2022

By: /s/

  
Reynold A. Panettieri, Jr.

## **Exhibit A**

## **CURRICULUM VITAE**

**DATE:** January 2022

**NAME:** Reynold A. Panettieri, Jr., MD

**PRESENT TITLE:** Professor of Medicine, Robert Wood Johnson Medical School  
Vice Chancellor for Translational Medicine and Science  
Director, Rutgers Institute for Translational Medicine and Science  
Emeritus Professor of Medicine, University of Pennsylvania

**HOME ADDRESS:** 423 Brister Road Bensalem, PA 19020

**OFFICE ADDRESS:** Rutgers Institute for Translational Medicine and Science  
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**TELEPHONE NUMBER / E-MAIL ADDRESS:**

Phone: 732-235-6404  
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**CITIZENSHIP:** USA

**EDUCATION:**

- A. Undergraduate  
St. Joseph's University  
Philadelphia, PA  
B.S. (Biology) Summa cum laude 1979
- B. Graduate and Professional  
University of Pennsylvania  
Philadelphia, PA  
M.D. 1983

**POSTGRADUATE TRAINING:**

- A. Internship and Residencies  
Hospital of the University of Pennsylvania  
Philadelphia, PA  
Internal Medicine  
1983-1986
- B. Research Fellowships  
Hospital of the University of Pennsylvania  
Philadelphia, PA  
Pulmonary Diseases  
1986-1989

**MILITARY:** N/A

**ACADEMIC APPOINTMENTS:**

- University of Pennsylvania  
Department of Medicine  
Research Associate  
1989-1990  
Assistant Professor  
1990 – 1996

Associate Professor with tenure  
1996-2001  
Robert L. Mayock & David A. Cooper Professor with tenure  
2001-2015  
Emeritus Professor  
2015- present

Wistar Institute – Philadelphia, PA  
Adjunct Assistant Professor  
1995-1996  
Adjunct Associate Professor  
1996-2001  
Adjunct Professor  
2001-15

Rutgers University  
Professor of Medicine, Robert Wood Johnson Medical School  
2015- present  
Joint Faculty Appointment  
Graduate Program in Toxicology  
Graduate School of Biomedical Sciences  
Rutgers School of Health Professions, Department of Health Informatics

**ADMINISTRATIVE APPOINTMENTS:**

University of Pennsylvania  
Director, Airways Biology Initiative  
2003-2015  
Director, Integrative Health Sciences Facility Core, Center of Excellence in Environmental Toxicology  
2007-2015  
Deputy Director, Center of Excellence in Environmental Toxicology  
2009-2015

Rutgers University  
Vice Chancellor, Translational Medicine and Science  
Rutgers Biomedical and Health Sciences  
2015- present  
Director, Rutgers Institute for Translational Medicine & Science  
2015- present  
Chancellor Scholar  
2015 - present  
Section Chief, Allergy and Asthma  
Division of Pulmonary and Critical Care Medicine  
Department of Medicine, Robert Wood Johnson Medical School  
2016 - present

**HOSPITAL APPOINTMENTS:**

University of Pennsylvania Health System,  
Philadelphia, PA  
Associate Director, Pulmonary Diagnostic Services  
1990-1991  
Director, Pulmonary Diagnostic Services  
1991-1994  
Co-Director, Cardiopulmonary Exercise Program  
1991-1994  
Pulmonary Director, Asthma Program  
1994-1995

Director, Comprehensive Asthma Program  
1995-2015  
Chief, Asthma Section, Pulmonary, Allergy & Critical Care Division  
1999-2015  
Associate Program Director, General Clinical Research Center  
2005-2015

Robert Wood Johnson University Hospital  
Attending Physician  
2015 – present

**OTHER EMPLOYMENT OR MAJOR VISITNG APPOINTMENTS: N/A**

**PRIVATE PRACTICE:** Robert Wood Johnson Physician Enterprise  
2015 - present

**LICENSURE:** Pennsylvania - MD032459E, exp 12/31/2022  
New Jersey - 25MA09773100, exp 6/30/2021

**DRUG LICENSURE:** New Jersey CDS: D1070150, exp 10/31/2021  
DEA: AP2928630, exp. 3/31/2022

**CERTIFICATION:** ABIM – 1986  
Pulmonary Medicine – 1988

**MEMBERSHIPS, OFFICES AND COMMITTEE ASSIGNMENTS IN PROFESSIONAL SOCIETIES:**

American College of Physicians  
American Thoracic Society  
Sigma Xi Scientific Research Society  
American College of Chest Physicians, Fellow  
Member, Nominating Committee, American Lung Association  
Member, Research Review Committee, American Lung Association  
Member, Program Committee, American Lung Association/American Thoracic Society,  
Respiratory Structure and Function Assembly  
Member, National Long Range Planning Committee, American Lung Association/American  
Thoracic Society, Respiratory Structure and Function Assembly  
Chairman, National Long Range Planning Committee, American Lung Association/American  
Thoracic Society, Respiratory Structure and Function Assembly  
Chairman, Program Committee, American Lung Association/American Thoracic Society,  
Respiratory Structure and Function Assembly  
Member, World Allergy Organization Scientific and Clinical Issues Council  
Chair, Nominating Committee, Respiratory Structure and Function Assembly, American Thoracic  
Society, 2012-13  
Chair, Respiratory Structure and Function Assembly, American Thoracic Society, 2014-16  
Member, Finance Committee, Respiratory Structure and Function Assembly, American Thoracic  
Society  
Member, Awards Committee, Respiratory Structure and Function Assembly, American Thoracic  
Society  
Member, Basic Science Core Working Group, Respiratory Structure and Function Assembly,  
American Thoracic Society

**HONORS AND AWARDS:**

1975-79 Presidential Scholarship Award  
1975-79 Dean's List  
1978-79 Alpha Sigma Nu (National Jesuit University Honor Society)  
1980 Alpha Epsilon Delta Northeastern United States Scholar Award for Medical  
School

1983	American Heart Association Undergraduate Research Award
1987	Outstanding Case Presentation Award, Eastern Regional American College of Physicians Meeting, Pittsburgh, PA
1988	Alpha Omega Alpha, National Medical School Honor Society
1991	Faculty, National Asthma Education Program, NHLBI/AAAI
1996	Career Investigator Award, American Lung Association/American Thoracic Society
1999	39 <sup>th</sup> Recipient of the Robert E. Cooke Memorial Lectureship, American Academy of Allergy, Asthma & Immunology (AAAAI) Meeting, Orlando, FL
1999	Member, John Morgan Society, Univ. of Pennsylvania
2000	Member, American Society for Clinical Investigation
2003	LAM Foundation Excellence in Research Award
2005	The John E. Salvaggio Memorial Lectureship, "Airway Remodeling," AAAAI 61 <sup>st</sup> Annual Meeting, San Antonio, TX (March)
2005	American Thoracic Society Parker B. Francis Speaker (May)
2007	Member, Association of American Physicians
2013	Joseph R. Rodarte Award for Distinguished Achievement and Contributions in Respiratory Physiology and Medicine, Respiratory Structure and Function Assembly, American Thoracic Society
2015	American Thoracic Society Recognition Award for Scientific Accomplishments

#### **BOARDS OF DIRECTORS/TRUSTEES POSITIONS:**

2014-16	American Thoracic Society Board of Directors
2020-2023	BioNJ Board of Trustees
2021-	National Association for Disabled Athletes

#### **SERVICE ON NATIONAL GRANT REVIEW PANELS:**

The Wellcome Trust, London, England, 1995
National Health and Medical Research Council, Canberra, Australia, 1996
Invited Ad Hoc Reviewer, National Institutes of Health, Lung Biology and Pathology Study Section, 1997
Invited Ad Hoc Reviewer, National Institutes of Health-National Institute of Allergy and Infectious Disease, 1997
Invited Ad Hoc Reviewer, National Institute of Environmental Health Science, 1997
Member, National Institutes of Health, Lung Biology and Pathology A Study Section, 2001-2004
Reviewer, LAM Foundation Research Grants, 2002- 2015
Chairman, National Institutes of Health, Lung Cellular, Molecular, and Immunobiology Study Section, 2004-2006
Ad Hoc Reviewer, National Institutes of Health, Lung Cellular, Molecular, and Immunobiology Study Section, Special Emphasis Panel, 2006-present
Reviewer, National Heart, Lung, and Blood Institute Loan Repayment Program, 2007-2010
Reviewer, National Heart, Lung, and Blood Institute Program Project Special Emphasis Panel (Wagner), 2007-08
Reviewer, American Medical Association Foundation Seed Grant Research Program, Secondhand Smoke Committee, 2008-09
Reviewer, National Institute of Environmental Health Sciences, ONES RFAs, March 2008
Reviewer, National Heart, Lung, and Blood Institute, Special Emphasis Panel, Small Grants for Lung Tissue Research (R03) RFA, July 2008
Reviewer, Raine Medical Research Foundation, University of Western Australia, Nedlands, Western Australia, 2008
Reviewer, Innovative Medicines Initiative Joint Undertaking, European Commission, Brussels, Belgium, 2008-09
Reviewer, National Heart, Lung, and Blood Institute LCMI Member Conflicts Panel, October 2008
Reviewer, National Heart, Lung, and Blood Institute, Special Emphasis Panel for LCMI Member Conflicts, June 2009
Reviewer, Cardiovascular and Respiratory Sciences Distinguished Editorial Panel, RFA-OD-09-003: Challenge Grants Panel 19, National Institutes of Health, July 2009

Chair and Reviewer, Shared Instrumentation Scientific Review Group, National Institutes of Health, November 2009  
Reviewer, National Institutes of Health, Center for Scientific Review College of Reviewers, 2010-2012  
Reviewer, Small Business Respiratory Sciences Special Emphasis Panel, National Institutes of Health, March 2010  
Reviewer, College of CSR Reviewers, National Centers for Biomedical Computing (U54), NIH, April 2010  
Reviewer, Hematology and Cardiovascular-Respiratory Sciences Distinguished Editorial Panel, ZRG1 VH-D55R-R-OD-10-005: RC4 Challenge Grants, National Institutes of Health, June 2010  
Reviewer, NIH Childhood Asthma Management Program (CAMP) CS/3 CT Scan Recommendation, October 2010  
Reviewer, Centers for Advanced Diagnostics and Experimental Therapeutics in Lung Diseases Stage I (CADET I) (P50) Special Emphasis Panel, November 2010  
Reviewer, Parker B. Francis Fellowship Program Council of Scientific Advisors, January 2011-2014  
Reviewer, National Heart, Lung, and Blood Institute, Special Review Committee, Program Project: Microbiome, Immunoregulation and Vitamin D Status in Allergy, February 2011  
Reviewer, National Heart, Lung, and Blood Institute, Cross Organ Mechanism-Associated Phenotypes for Genetic Analyses of Heart, Lung, Blood, and Sleep Diseases, March 2011  
Reviewer, Agency for Healthcare Research and Quality Evidence-Based Practice Center Program, January 2012  
Reviewer, National Institutes of Health, PAR Developmental Pharmacology Special Emphasis Panel, March 2012  
Reviewer, National Institute of Environmental Health Sciences, Environmental Health Sciences P30 Review Committee, September 2013  
Reviewer, National Heart, Lung, and Blood Institute Loan Repayment Program, April-May 2014  
Reviewer, Creighton University/State of Nebraska LB595 Cancer and Smoking Disease Research Program Development Grants, June 2015  
Reviewer, Outstanding New Environmental Scientist R01 Award, National Institute of Environmental Health Sciences, July 2015  
Reviewer, Member Special Emphasis Panel, National Institutes of Health, October-November 2015  
Reviewer, Penn Orphan Disease Center LAM Pilot Grant Application, November 2015  
Reviewer, Member Special Emphasis Panel, National Institutes of Health/National Center for Advancing Translational Sciences, May 2016  
Reviewer, National Heart, Lung, and Blood Institute Loan Repayment Program, March-April 2017  
Reviewer, National Institutes of Health Lung Cellular, Molecular and Immunobiology Study Section, July 2017 – June 2021

**SERVICE ON MAJOR COMMITTEES: (see above also)**

Advisory Boards:  
LAM Foundation Scientific Advisory Board  
2001-present  
Chair, Data Safety and Monitoring Board for the Severe Asthma Research Program, NIH/NHLBI  
2002-present  
Member, Protocol Review Committee for the Asthma Clinical Research Network II, NIH/NHLBI  
2004-present  
Member, NIAID Allergy/Asthma H1N1 Ad Hoc Data Safety and Monitoring Board  
2009  
Member, NHLBI Asthma Outcomes Workshop  
2009-10  
Member, NIEHS Workshop for Human Exposure Studies  
2010  
Member, NIH CounterACT Steering Committee  
2011  
Member, Asthma and Allergy Foundation of America, Medical-Scientific Council Rapid Response Team  
2015- present  
Member, American College of Allergy, Asthma and Immunology Asthma Yardstick Committee  
2016  
Member, American Thoracic Society, Finance Committee  
2017

Member, American Thoracic Society RSF Basic Science Core Working Group  
2017  
Member, Registry of Patient Registries (ROPR) Outcome Measures Framework  
2017  
Member, NHLBI Protocol Review Committee for the Precision Interventions for Severe and/or  
Exacerbation Prone Asthma  
2018-present  
Member, External Advisory Board, Clinical and Translational Science Institute, University of Pittsburgh,  
2020-2023  
Member, External Advisory Board, Center for Clinical and Translational Sciences, University of Texas  
Health Science Center  
2021-2024

**ORGANIZING/PARTICIPANT ROLES IN SCIENTIFIC MEETINGS:**

- 1993 Mini-Symposium Chairman, "Airway Smooth Muscle Cell Hyperplasia," American Lung Association (ALA)/American Thoracic Society (ATS) International Conference, San Francisco, CA  
1994 Poster Discussion Symposium Chairman, "Airway Smooth Muscle Cell Proliferation," ALA/ATS International Conference, Boston, MA  
1995 Chairman, Symposium on Asthma Management in Managed Care Organizations, Chicago, IL  
1995 Poster Discussion Symposium Chairman, "Airway Smooth Muscle Cell Proliferation," ALA/ATS International Conference, Seattle, WA  
1995 Co-Chairman, Symposium on Airway Smooth Muscle Cell Proliferation, Joint ALA/ATS and AAAI Conference, Chicago, IL  
1996 Chairman, Grand Symposium, "Case for Case Management in Asthma," New Orleans, LA  
1996 Co-Chairman, "Airway Smooth Muscle Cell Activation," ALA/ATS International Conference, New Orleans, LA  
1997 Chairman, Symposium on Airway Remodeling, ALA/ATS International Conference, San Francisco, CA  
1997 Chairman, Symposium on Asthma Disease State Management, ALA/ATS International Conference, San Francisco, CA  
1997 Workshop Moderator, "Reactive Airways Disease: Etiology, Diagnosis and Management," Cottle International Rhinology Centennial, Philadelphia, PA  
1998 Chairman, Symposium on Airway Smooth Muscle Function in Asthma, ALA/ATS International Conference, Chicago, IL  
1998 Chairman, Workshop on Airway and Pulmonary Vascular Smooth Muscle Function in Health and Disease," Sundance, Utah  
1999 Chairperson and Plenary Speaker, Respiratory Pharmacology and Airways Disease, Southeast Asia-Western Pacific International Pharmacology Meeting, Taipei, Taiwan  
1999 Chairperson, Research Directions in Asthma, Mid-Atlantic Regional Asthma Consortium, Johns Hopkins University, Baltimore, MD  
2000 Chairman, Nominating Committee, Respiratory Structure and Function Assembly, American Thoracic Society  
2000 Chairman and Presenter, Session on Airway Smooth Muscle Function, World Congress on Lung Health and 10<sup>th</sup> European Respiratory Society Annual Congress, Florence, Italy  
2001 Co-Chairman, Minisymposium, "New Understandings in the Basic Mechanisms of Asthma," AAAAI 57<sup>th</sup> Annual Meeting, New Orleans, LA  
2002 Chair, Basic/Clinical Science LAM Conference, "Smooth Muscle," The LAM Foundation/NHLBI Research Conference, Cincinnati, OH  
2003 Chair, Basic Science, The LAM Foundation/NHLBI Research Conference, Cincinnati, OH  
2003 Work Group Leader, Future Research Directions in Asthma Workshop, National Institutes of Health, Rockville, MD  
2003 Chairman, International Congress on Airway Smooth Muscle Function in Asthma & COPD, Miami, FL  
2004 Chairman, Pathophysiology Special Issues Board, New York, NY  
2005 Co-Director, Clinical Skills Workshop on Office-Based Procedures: Spirometry, American College of Physicians Annual Session, San Francisco, CA  
2005 Chairman, Poster Discussion Session on "Modulation of Allergic Inflammation," American Thoracic Society International Conference, San Diego, CA  
2005 Participant, National Center for Complementary and Alternative Medicine Symposium on Integrating Mind, Brain and Periphery: Mechanisms in Asthma and Atherosclerosis, Airlie Conference Center, Warrenton, VA

- 2005 Participant, Cystic Fibrosis Foundation/National Heart, Lung, and Blood Institute Workshop on Adult Stem Cells, Lung Biology, and Lung Disease, University of Vermont, Burlington, VT
- 2006 Discussion Leader, "Airway Remodeling in Asthma," American Academy of Allergy, Asthma & Immunology 62<sup>nd</sup> Annual Meeting, Miami, FL
- 2006 Co-Director, Clinical Skills Workshop on Office-Based Procedures: Spirometry, American College of Physicians Annual Session, Philadelphia, PA
- 2006 Speaker, Educational Symposium for AIR2 Trial: Investigating Bronchial Thermoplasty for Severe Asthma, "The Role of Airway Smooth Muscle in Asthma," San Diego, CA
- 2006 Panel Discussion Leader, Workshop on Advances in Small Animal Imaging: Application to Lung Pathophysiology, American Thoracic Society International Conference, San Diego, CA
- 2006 Chair, Scientific Symposium on Intracellular or Extracellular Strategies for Controlling Asthma/COPD Remodeling: Which is Best? and Speaker, "Pros and Cons of Targeting Extracellular vs. Intracellular Mechanisms: What Can We Learn?" American Thoracic Society International Conference, San Diego, CA
- 2006 Chair, National Heart, Lung, and Blood Institute Workshop, "Role of Airway Smooth Muscle in Bronchomotor Tone, Inflammation and Remodeling: Advancing from Basic Knowledge to Clinical Relevance," Rockville, MD
- 2006 Chairperson and Invited Speaker, "Airway Remodeling: Fact or Fiction?" International Symposium on Recent Research Advances in Asthma Pathogenesis, St. John's, Antigua
- 2007 Co-Chair, Mini Symposium, "Mechanisms Regulating Airway Smooth Muscle Phenotype and Function," American Thoracic Society International Conference, San Francisco, CA
- 2007 Co-Chair, Scientific Symposium, "Controversies in Pulmonary and Critical Care Medicine," American Thoracic Society International Conference, San Francisco, CA
- 2007 Chairperson, Workshop on the Impact of Environmental Nano Particles on Allergy and Asthma, XXVI Congress of the European Academy of Allergology and Clinical Immunology (EAACI), Göteborg, Sweden
- 2008 Symposium Co-Chair, "New Drugs: Targeting Inflammation in Disease," 15<sup>th</sup> International Inflammation Research Association Conference, Chantilly, VA
- 2009 Co-Chair, Symposium on MicroRNA: Regulation of Lung Cell Function, and Speaker, "MicroRNAs Modulate Beta 2 Tolerance in Human Airway Smooth Muscle," American Thoracic Society International Conference, San Diego, CA
- 2009 Lead Facilitator, Thematic Poster Session on The Cytoskeleton and Cell Contractility, American Thoracic Society International Conference, San Diego, CA
- 2009 Thematic Poster Session Presenter, "Comparison of Efficacy and Safety of Arformoterol 15 µg Twice Daily with Arformoterol 30 µg Once Daily in Patients with COPD," American Thoracic Society International Conference, San Diego, CA
- 2009 Mini Symposium Presenter, "miR-132 Modulates β<sub>2</sub>-Adrenergic Receptor Desensitization in Human Airway Smooth Muscle Cells," American Thoracic Society International Conference, San Diego, CA
- 2010 Symposium Speaker, "Vitamin D and Human Airway Smooth Muscle Function in Asthma," Scientific Symposium on Vitamin D and the Lung: Emerging Concepts, American Thoracic Society International Conference, New Orleans, LA
- 2011 Symposium Speaker, "Environment-Driven Epithelial Effects on Smooth Muscle Function," Scientific Symposium on Epithelial-Mesenchymal Crosstalk: A Matrix for Lung Remodeling, American Thoracic Society International Conference, Denver, CO
- 2011 Poster Discussion Session Co-Chair, Mechanisms of Airway Hyperresponsiveness in Asthma, American Thoracic Society International Conference, Denver, CO
- 2011 Mini Symposium Presenter, "RGS4 Modulates PDGF-Induced MMP-9 Expression in Human Airway Myocytes," American Thoracic Society International Conference, Denver, CO
- 2011 Discussant, Sixth Annual Nemacolin Asthma Conference, Farmington, PA
- 2011 Symposium Speaker, "Response Element," Smooth Muscle and Asthma Symposium, World Allergy Congress, Cancun, Mexico
- 2011 Session Co-Chair, Long-Acting Beta Agonists vs. Tiotropium for Asthma, World Allergy Congress, Cancun, Mexico
- 2011 Symposium Discussant, Overview of Asthma and Mind Brain Body Research, Mind Brain Body Health Initiative Final Symposium, Palm Beach, FL
- 2011 Symposium Speaker, "Animal Models in Asthma," Mind Brain Body Health Initiative Final Symposium, Palm Beach, FL
- 2012 Discussant, Seventh Annual Nemacolin Asthma Conference, Farmington, PA

2013 Primary Speaker, "New Therapeutic Strategies Targeting Airway Smooth Muscle," Q&A Workshop on Airway Smooth Muscle Signaling: New Insights in Asthma, AAAAI Annual Meeting, San Antonio, TX  
2013 Faculty, Ninth Annual Respiratory Disease Young Investigators Forum, Austin, TX  
2013 Fellows Program Co-Director and Conference Discussant, Eighth Annual Nemacolin Asthma Conference, Farmington, PA  
2014 Co-Chair, Plenary Session: COPD: Effects Beyond the Lungs, COPD Istanbul 2014, Istanbul, Turkey  
2014 Symposium Speaker, "Developing Biological Options for Patients with Severe Asthma and Eosinophilic Inflammation," International Pipeline Symposium, American Thoracic Society International Conference, San Diego, CA  
2014 Chair and Primary Reviewer, Grant 1, Career Development Workshop: Understanding the Grant Review Process, American Thoracic Society International Conference, San Diego, CA  
2014 Symposium Speaker, "Molecular and Cellular Mechanisms of Airway Obstruction in Asthma," World Allergy Forum Symposium, "Origins of Severe Airway Diseases," European Academy of Allergy and Clinical Immunology Congress, Copenhagen, Denmark  
2014 Faculty, Tenth Annual Respiratory Disease Young Investigators Forum, Washington, DC  
2014 Symposium Speaker, "Asthma: Novel Approaches and New Targets," Veterinary Comparative Respiratory Society, New Bolton Center Hospital, Kennett Square, PA  
2014 Symposium Speaker, "Immunologic and Physiologic Assessment of Chronic Airway Obstruction," American College of Allergy, Asthma & Immunology Annual Scientific Meeting, Atlanta, GA  
2014 Plenary Session Speaker, "Systemic Manifestations and Co-Morbidities of COPD," American College of Allergy, Asthma & Immunology Annual Scientific Meeting, Atlanta, GA  
2014 Meet the Professor Session Speaker, "Severe Asthma," American College of Allergy, Asthma & Immunology Annual Scientific Meeting, Atlanta, GA  
2015 Symposium Speaker, "Genotype-Specific Rhinovirus Induced Changes in Airway Smooth Muscle Hyperresponsiveness," American Thoracic Society International Conference, Denver, CO  
2015 Workshop Speaker, "Writing for Success," Workshop on Making an Impact with Your Science, American Thoracic Society International Conference, Denver, CO  
2015 Co-Chair, Poster Discussion Session: Airway Inflammation and Hyperresponsiveness: Novel Mechanisms and Therapy, American Thoracic Society International Conference, Denver, CO  
2015 Co-Chair, Poster Discussion Session: Fresh Perspectives on Airway Remodeling: From the Rocky Mountain High to Country Roads, American Thoracic Society International Conference, Denver, CO  
2015 Oral Presentation: What Is the Role of Lung Inflammation in Mediating Particulate Matter and Ozone Exposure Effects on Health and Disease? Session on Health Impacts of Atmospheric Particles, Goldschmidt Conference, Prague, CZ  
2016 Chairman, twelfth Annual Respiratory Disease Young Investigators' Forum, Chicago, IL  
2016 Fellows Program Director, Eleventh Annual Nemacolin International Asthma Conference, Farmington, PA  
2017 Chair, Thirteenth Annual Respiratory Disease Young Investigators' Forum, Chicago, IL  
2017 Fellows Program Director, Twelfth Annual Nemacolin International Asthma Conference, Farmington, PA  
2018 Chair, Fourteenth Annual Respiratory Disease Young Investigators' Forum, Washington, DC  
2018 Fellows Program Director, Thirteenth Annual Nemacolin International Asthma Conference, Farmington, PA  
2019 Chair, Fifteenth Annual Respiratory Disease Young Investigators' Forum, Chicago, IL  
2019 Fellows Program Director, Fourteenth Annual Nemacolin International Asthma Conference, Farmington, PA

#### **Other Participant Roles**

1991 Director, Adult Asthma Patient Education Program, city-wide program sponsored by the American Lung Association  
1995 Spokesperson Concerning Asthma, American Lung Association of Southeastern Pennsylvania  
1995-05 Advisory Council, American Lung Association of Southeastern Pennsylvania Metropolitan Area  
1995-05 Research Council, American Lung Association of Southeastern Pennsylvania  
1995-05 Philadelphia Asthma Task Force  
1996-07 Asthma Task Force, American Lung Association of Southeastern Pennsylvania  
1996-05 National Research Grant Review Committee, American Thoracic Society  
1996-04 Program Committee, Respiratory Structure and Function Assembly, American Thoracic Society  
1997-04 Long Range Planning Committee, Respiratory Structure and Function Assembly, American Thoracic Society  
1997-07 Member, Board of Directors, American Lung Association of Southeastern Pennsylvania  
2000 Co-Chairperson, Attack Asthma Program, American Lung Association of Southeastern Pennsylvania

2001-08 Co-Chairperson, Allies Against Asthma, Robert Wood Johnson Foundation Award  
2006 Chairman, Pri-Med Updates, SCIOS Continuing Education  
2006 Chairman, Pri-Med Online Asthma Condition Center, SCIOS Continuing Education

#### **EDITORSHIPS**

Co-Editor-in-Chief: Respiratory Research  
Senior Editor: British Journal of Pharmacology  
Editor: Scientia, Medical Education Network, New York  
Associate Editor: American Journal of Respiratory Cell & Molecular Biology  
Associate Editor: Frontiers in Pharmacotherapy of Respiratory Diseases  
Managing Editor, Frontiers in Bioscience

#### **EDITORIAL BOARD:**

American Journal of Respiratory Cell & Molecular Biology  
American Journal of Physiology: Lung Cellular and Molecular Physiology  
British Journal of Pharmacology  
Current Respiratory Medicine Reviews  
European Medical Journal, Allergy and Immunology  
Journal of Pulmonary and Respiratory Medicine  
Journal of Clinical & Experimental Toxicology  
Pharmacologia  
Respiratory Research  
Therapeutic Advances in Respiratory Disease  
Thorax  
Translational Research

#### **REVIEWER:**

American Journal of Physiology: Cell Physiology  
American Journal of Physiology: Lung Cellular and Molecular Physiology  
American Journal of Respiratory & Critical Care Medicine  
American Journal of Respiratory Cell & Molecular Biology  
Annals of Internal Medicine  
Canadian Journal of Physiology & Pharmacology  
Cleveland Clinic Journal of Medicine  
Current Respiratory Medicine Reviews  
European Journal of Pharmacology  
European Respiratory Journal  
Journal of Allergy and Clinical Immunology  
Journal of Applied Physiology  
Journal of Clinical Investigation  
Journal of Immunology  
Nature Medicine  
New England Journal of Medicine  
Proceedings of the National Academy of Sciences, USA  
Proceedings of the American Thoracic Society  
Pulmonary Pharmacology & Therapeutics  
Respiratory Research  
Thorax

#### **SERVICE ON SCHOOL COMMITTEES:**

##### **University of Pennsylvania**

1989-90 Student-Faculty Interaction Committee  
1990-92 Student-Faculty Advisor  
1992-02 Internship Selection Committee  
2004-06 Member, Committee for Academic Review of Department of Physiology  
2010-15 Reviewer, University Research Foundation Biomedical Review Panel  
2011-15 Member, Department of Medicine Committee on Appointments and Promotions  
2013- Member, Pharmacology Graduate Group

**Rutgers Biomedical and Health Sciences**

- 2017 Member, RBHS Commencement Committee  
2018- Member, Department of Medicine Mentoring Committee  
2018 Member, Search Committee for RBHS Provost for Newark Campus  
2018-19 Chair, Ernest Mario School of Pharmacy School Review Committee  
2018- Chair, Rutgers Health Group Clinical Trials Committee  
2018 Member, Cost Pool Advisory Committee for Research Administration  
2018- Core Faculty Member, Rutgers Global Health Institute  
2018 Robert Wood Johnson Medical School Clinical Research Center Advisory Committee  
2018- Rutgers Health Group IT Informatics and Analytics Committee  
2018-20 Member, RWJBH EHR Selection Committee  
2018- Member, Clinical Research Data Warehouse Committee  
2018- Member, Clinical Investigations and Precision Therapeutics Program, Rutgers Cancer Institute of NJ  
2020- Chair, Rutgers Brain Health Institute Review Committee  
2020-21 Co-Chair, RBHS Chancellor Review Committee  
2020- Member, RBHS Strategic Plan Steering Committee  
2020- Co-Chair, RBHS Strategic Plan Research Subcommittee  
2021- Member, Search Committee for RBHS Vice Chancellor for Population Health  
2021- Member, Executive Committee, NJ Practice-Based Research Network

**SERVICE ON UNIVERSITY COMMITTEES**

- 2016 Member, Rutgers Cancer Institute of New Jersey Director Search Committee  
2017- Member, Rutgers Cancer Institute of New Jersey Internal Advisory Board  
2018- Member, Rutgers University President's Administrative Council  
2018- Co-Chair, RWJ Barnabas Health/Rutgers Master Affiliation Research Committee  
2018- Member, Committee to Develop The Hub

**SERVICE ON HOSPITAL COMMITTEES:** None

**SERVICE TO THE COMMUNITY:**

- 1991 Director, Adult Asthma Patient Education Program, City-Wide Program Sponsored by the American Lung Association  
1995-05 Research Council, American Lung Association of Southeastern Pennsylvania  
1996-07 Asthma Task Force, American Lung Association of Southeastern Pennsylvania  
2000 Co-Chairperson, Attack Asthma Program, American Lung Association of Southeastern Pennsylvania  
2001-08 Co-Chairperson, Allies Against Asthma, Robert Wood Johnson Foundation Award

**SPONSORSHIP (Primary Mentorship) OF PRE-/POSTDOCTORAL FELLOWS:**

- 1991-93 Gulsevil Bilgen, M.D., Postdoctoral Fellow  
1991-93 Nathalie Frey, M.D., Postdoctoral Fellow  
1993-98 Aili L. Lazaar, M.D., Postdoctoral Fellow (K08 Awardee, R01 Recipient, ALA Career Investigator Awardee)  
1994-96 Melissa Cohen, M.D., Postdoctoral Fellow  
1995-01 Vera Krymskaya, Ph.D., Visiting Scientist, Institute of Experimental Cardiology, Moscow, Russia (American Heart Association Research Grant Recipient, LAM Foundation Research Grant Recipient, R01 Recipient, currently Professor of Medicine with Tenure, University of Pennsylvania)  
1996-01 Dr. Yassine Amrani, Postdoctoral Fellow (Parker B. Francis Fellow, R01 Recipient, currently Associate Professor, University of Leicester, UK)  
1996-01 Dr. Hang Chen, Postdoctoral Fellow  
1995-96 Indira Gurubhagavatula, M.D., Postdoctoral Fellow (currently Associate Professor of Medicine, University of Pennsylvania)  
1996-01 Rebecca Hoffman, Ph.D., Research Associate (currently Assistant Professor, Rowan University)  
1996-01 Alaina J. Ammit, Ph.D., CJ Martin Fellowship Awardee, NHMRC, Australia  
1997-98 Evgenia Gerasimovskaya, Ph.D., Postdoctoral Fellow  
1998 Daniela Levi, M.D., Postdoctoral Fellow  
1999-00 Liza C. O'Dowd, M.D., Research Associate (K23 NIH Grant Awardee)  
2000-01 Angela Haczku, M.D., Ph.D., Research Associate Professor (Parker B. Francis Awardee, R01 Recipient, currently Professor of Medicine, University of California, Davis)

2001-05 Elena Goncharova, Ph.D., Postdoctoral Fellow (currently Associate Professor, Vascular Medicine Institute, University of Pittsburgh)  
2001-03 Chien-Da Huang, M.D., Visiting Professor  
2002-05 Jenny Kim, M.D., Postdoctoral Fellow  
2002-05 Omar Tliba, D.V.M., Ph.D., Postdoctoral Fellow  
2005-07 Omar Tliba, D.V.M., Ph.D., Research Associate (Recipient of ALA Grant, Parker B. Francis Fellowship, NIH K99, currently Associate Professor, Thomas Jefferson University School of Pharmacy)  
2006-11 Gautam Damera, Ph.D., Postdoctoral Fellow (Scientist, Respiratory & Translational Sciences Division, MedImmune)  
2006-10 Audreesh Banerjee, M.D., K08 Awardee, Adjunct Assistant Professor of Medicine, University of Pennsylvania; Pulmonary Fellowship Director, Christiana Hospital  
2007-10 Philip R. Cooper, Ph.D., Postdoctoral Fellow (Research Scientist, J&J Biologics Center of Excellence)  
2007-12 Michael W. Sims, M.D., K23 Awardee, Assistant Professor of Medicine, University of Pennsylvania  
2009-14 Cynthia Koziol-White, Ph.D., Postdoctoral Fellow, Research Associate, University of Pennsylvania  
2010 Yuki Muroyama, Exchange Student, University of Tokyo Graduate School of Medicine  
2011 Ikuo Takazawa, Exchange Student, University of Tokyo Graduate School of Medicine  
2012-15 Joseph Jude, B.V.Sc., Ph.D., CEET Postdoctoral Fellow, University of Pennsylvania  
2012-18 Edwin Yoo, B.S., M.S., Pharmacology Graduate Student, University of Pennsylvania  
2014-18 Christie Ojiaku, B.S., Pharmacology Graduate Student, University of Pennsylvania  
2014- Sarah Orfanos, M.D.  
2014-15 Bilal Haq, M.S.  
2015 Zhiyun Guo, Ph.D., Visiting Scholar, Associate Professor, Southwest Jiaotong University, Chengdu City, China  
2015 Jia Hou, M.D., Ph.D., Visiting Scholar, Associate Chief Physician, Respiratory and Critical Care Medicine, General Hospital of Ningxia Medical University, Ningxia, China  
2016 Jasvinder Singh, M.D. Pulmonary Fellow, Robert Wood Johnson Medical School  
2018 Ibrahim El Hussein, M.D. Pulmonary Fellow, Robert Wood Johnson Medical School  
2018- Shengjie Xu, Translational Medicine and Science Graduate Student, Rutgers University  
2018-20 Elena Chung, M.S., Toxicology and Pharmacology, Rutgers University (pursuing Ph.D, Rutgers Camden)  
2019 Natalia Levytska, M.D. Pulmonary Fellow, Robert Wood Johnson Medical School  
2019 Jeffrey Yung, M.D. Pulmonary Fellow, Robert Wood Johnson Medical School  
2020 Kevin Dazen, M.D. Pulmonary Fellow, Robert Wood Johnson Medical School  
2020-21 Joanna Woo, Doctoral Candidate Toxicology Program, Rutgers University New Brunswick  
2021 Jared M. Radbel, M.D. Pulmonary Fellow, Robert Wood Johnson Medical School  
2021 Joshua L. Kennedy, M.D. Associate Professor of Pediatrics Allergy and Immunology, University of Arkansas for Medical Sciences

**Thesis Committee:**

1999 Darren Fernandes  
2017 Edwin Yoo  
2018 Christie Ojiaku  
2018 Barbara Tafuto  
2020 Shengjie Xu

**Undergraduate Student Research Trainees:**

2010 Colleen McNulty  
2010 Evan Huzinec  
2011-14 Jackie Scala  
2011-14 Michael Phan  
2011-14 Martin Johnson  
2012 Christina Nikolos  
2012 Caroline Zhong  
2012 Edwin Yoo (medical student)  
2012-13 Stephane Guillou  
2012-13 Mi Thant Mon Soe  
2012-14 Kevin MacDonald

2013	Kevin Truskowski
2013	Aakanksh Jaikumar
2013	Andrew Parambath
2013-14	Alexa Carboni
2013-14	Yuxin Ouyang
2013-14	Eleni Papanikolaou
2014	Megan Levis
2014	Michael Klichinsky
2014	Isabelle Lee
2014	Kim Nguyen (medical student)
2014	Stephen Zachariah
2014-15	Ngan Nguyen
2014-15	Sayaka Ogawa
2014-15	Sofia Gomez
2014-15	Ricki Levitus
2015	Hollie Brown
2015	Damie Juat
2015	Jennifer Viveiros
2015	Ankit Shah
2015	Akber Sheikh
2015	Krishna Sunder
2016	Corinne Corbi
2016	Nikhil Karmacharya
2016	Yoon Mi Kim
2016	Jaehee Yang
2016	Riva Patel
2016	Ana Lucia Fuentes
2016	Fady Karem Soliman
2016	Kim Nguyen
2016	Ritesh Akkisetty
2016	John Gow
2017	Sanjiv Sunderam
2017	Varun Gongireddy
2017	Sahana Kannan
2017	Alina Lou
2017	Caroline Ben Nathan
2017	Jennifer Ben Nathan
2017	Corrine Corbi
2017	Erik Gage
2017	Kirthina Ali
2018	Noah Hartwick
2018	Shreyas Hebbal
2018	Virginia Tanner
2018	Jazmean Williams
2018	Julian Rana
2018	Nila Kirupharan
2019	Leah Dobossy
2019	Joshua Jose
2019	Neenakshi Kotcherlakota
2019	Ankita Prasad
2019	Lily Kwak
2019	Amanda Smalfus
2019	Elizabeth Titova
2019	Sierra Triolo
2019	Alina Lou
2019	Anthony Saad
2019	Frank Pelligrino
2019	Seung Ah Choi
2019	Grant Shim

2019	Olivia Mayfryer
2019	Serena Wang
2019	Rohan Sanghani
2020	Alina Lou
2020	Ankita Prasad
2020	Anthony Saad
2020	Joanna Woo
2020	Alexandra Heck
2020	Steven DeLuca
2020	David Flynn
2020	Eric Gebski
2020	Kelly Herman
2020	Brian Miyata
2020	Soham Patel
2020	Zach Hart Rosenthal
2020	Sam Schonwald

**MAJOR TEACHING RESPONSIBILITIES:**

1989-15	Attending Physician, Hospital of the University of Pennsylvania
1989-15	Ambulatory Care Lecturer, Section of General Medicine, Hospital of the University of Pennsylvania
1990-15	ID-205, Pathophysiology of Emphysema
1991-92	ME100, Patient-Doctor Relations
1992-93	ID-302, Interdisciplinary Emergency Management, "Approach to the Dyspneic Patient"
1993-15	Pharmacology 100, "Asthma"
1990	"Management of Life-Threatening Asthma," Grand Rounds, Crozer-Chester Medical Center, Chester, PA
1990	"Management of the Asthmatic Patient," Annual Meeting of Philadelphia Health PASS Physicians, Philadelphia, PA
1991	"Life-Threatening Asthma," Grand Rounds, Sacred Heart Hospital, Allentown, PA
1991	"Alternative Therapies for Severe Asthmatic Patients," Grand Rounds, Chester County Hospital
1991	"Increasing Asthma Mortality: Possible Etiologies," Grand Rounds, Riddle Memorial Hospital
1991	"Who Is at Risk for Death From Asthma?" Warminster General Hospital
1991	"Insights Into Asthma Management," Doylestown Hospital
1991	"Cellular Mechanisms Regulating Airway Smooth Muscle Cell Growth," American Institute of Biological Sciences, St. Joseph's University
1991	"New Therapy for Severe Asthma," Medical Grand Rounds, Veterans Administration Hospital
1991	"Pulmonary Function and Exercise Testing," Research Seminar, Bio-Pharm Clinical Services
1991	"Therapy for the COPD Patient," Visiting Professor, Fairmount Medical Center
1992	"Asthma Therapy in the '90s," Medical Grand Rounds, Taylor Hospital
1992	"Update – Treatment of COPD," Medical Grand Rounds, Riddle Memorial Hospital
1992	"Asthma: Morbidity and Mortality Increases," Medical Grand Rounds, North Penn Hospital
1992	"Asthma Therapy: New Perspectives," Hahnemann University Hospital
1992	"Asthma: A Need for Better Therapy," Medical College of Pennsylvania
1992-94	"Asthma: New Approaches for Therapy," Medical Grand Rounds, Christiana Hospital
1993	"Asthma Management: The Changing Approach," Grand Rounds, Episcopal Hospital
1993	"Fatal Asthma," Grand Rounds, Abington Hospital
1993	"Asthma: New Insights into Pathogenesis and Management," Grand Rounds, Holy Redeemer Hospital
1993	"Asthma in the '90s," Grand Rounds, Lower Bucks Hospital
1993	"Asthma," Grand Rounds, St. Francis Hospital, Delaware
1993	"Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Proliferation: In Vivo Correlates," Research Seminar, Pulmonary Division, Temple University School of Medicine
1993	"Asthma in the '90s," Grand Rounds, Frankford Hospital
1993	"Fatal Asthma," Grand Rounds, Riverview Medical Center
1994	"The Use of Pulmonary Function Tests," Medical Grand Rounds, St. Agnes Medical Center
1994	"Airway Smooth Muscle: More Than a Contractile Cell," SmithKline Beecham Pharmaceuticals, King of Prussia, PA
1994	"Asthma," Grand Rounds, Albert Einstein Medical Center

1994 "Asthma Therapy Today," Grand Rounds, Fitzgerald Mercy Hospital, Darby, PA  
1994 "New Therapies in Asthma," Surgical Grand Rounds, University of Pennsylvania Medical Center  
1994 "Asthma in the '90s," Medicine Grand Rounds, Allentown Hospital  
1994 "Asthma: An Irreversible Disease," Medical Grand Rounds, University of Pennsylvania Medical Center  
1995 "Asthma Today," Deborah Heart & Lung Center, Browns Mills, NJ  
1995 "Update on Asthma," North Penn Hospital, Lansdale, PA  
1995 "Therapy for the Asthmatic Patient," Fairmount Medical Center  
1996-97 "Update on Asthma Therapy," Grand Rounds, VA Medical Center, Philadelphia, PA  
1996 "Update on Asthma Therapy," Grand Rounds, Presbyterian Medical Center, Philadelphia, PA  
1996 "Asthma in the '90s," Grand Rounds, Pottsville Hospital  
1996-97 ME100, Patient-Doctor Relations  
1997 "Asthma in the '90s," Grand Rounds, Albert Einstein Medical Center, Philadelphia  
1998 "Management of COPD/Asthma," Temple University School of Pharmacy, Philadelphia, PA  
1999-14 Curriculum 2000, Respiratory Medicine: Obstructive Diseases: Asthma, Pharmacology  
2000-02 "Update on Asthma," University of Pennsylvania  
2002-06 Participating Faculty, Pre-Medical Summer Enrichment Program, Center of Excellence on Minority Health  
2004-15 Curriculum 2000, Module 4, Clinical Therapeutics Course, Asthma Presentation  
2007-present Lecturer, ENVS 408: Urban Asthma Epidemic Course, Earth & Environmental Science Department  
2008 Judge, 7<sup>th</sup> Annual Biomedical Postdoctoral Research Symposium  
2009-10 Moderator, Internal Medicine Core Clerkship: From Bedside to Bench (and Back)  
2010-14 Participant, Careers in Medicine Core Clerkship Mentoring Lunch  
2010-present Lecturer, Frontiers in Environmental Health Science Course  
2011-14 Pulmonary Module 2 Workshop Leader  
2012-present Lecturer, ENVS 406: Community-Based Environmental Health Course  
2015 Lecturer, BIOM 502: Molecular Basis of Disease: Asthma  
2015-16 Lecturer, PHRM 590: Inhalation Toxicology: Respiratory Physiology and Mechanisms of Lung Injury  
2015 "Occupational Asthma," Lecture for Occupational Medicine Residency Program, Hospital of the University of Pennsylvania  
2016 "Airway Smooth Muscle: A Therapeutic Target in Severe Persistent Asthma". The Joseph and Suzanne Seidemann Lecture in Pulmonary and Critical Care, Robert Wood Johnson Medical School, Rutgers University  
2017-18 "Inhalation Toxicology: Respiratory Physiology" for GGPS-PHRM 590, University of Pennsylvania Perelman School of Medicine  
2017-18 "Inhalation Toxicology: Mechanisms of Lung Injury" for GGPS-PHRM 590, University of Pennsylvania Perelman School of Medicine  
2019 "Inhalation Toxicology: Respiratory Physiology" for GGPS-PHRM 590, University of Pennsylvania Perelman School of Medicine  
2019 "Inhalation Toxicology: Mechanisms of Lung Injury" for GGPS-PHRM 590, University of Pennsylvania Perelman School of Medicine

#### **CLINICAL RESPONSIBILITIES:**

1990-2015 Attending Physician, Pulmonary Consult and Intensive Care Unit Services, Hospital of the University of Pennsylvania  
2015-present Attending Physician, Pulmonary and Critical Care Medicine, Robert Wood Johnson University Hospital

#### **GRANT SUPPORT:**

#### **CURRENT - PRINCIPAL INVESTIGATOR**

National Institutes of Health/NCATS, UL1TR003017, "New Jersey Alliance for Clinical and Translational Science" (NJ ACTS), Program Director/PI, 2019-2024, Total Funding \$4,776,211

National Institutes of Health/NCATS, UL1TR003017-02S1 “New Jersey Alliance for Clinical and Translational Science” (NJ ACTS), Program Director/PI, 2019-2024, Total Funding \$1,482,000

National Institutes of Health/NCATS, UL1TR003017-02S2, “New Jersey Alliance for Clinical and Translational Science (RADxUP Supplement – NJ HEROES TOO)”, Program Director/PI, 2019-2024, Total Funding \$3,792,941

National Institutes of Health/NHLBI, 1P01-HL114471-01A1, “Novel Molecular Mechanisms Promote GPCR-Induced Bronchodilation in Asthma,” Project Leader/PI, 2013-2024, Total Funding \$2,290,948

National Institutes of Health/NHLBI, 1P01-HL114471-01A1, Leader Project 1: TGF-beta1 directly modulates excitation-contraction signaling in airway smooth muscle to evoke airway hyperresponsiveness in asthma, 2013-2024

National Institutes of Health/NHLBI, 1P01-HL114471-01A1, Leader of Core B “Human Cell and Tissue Acquisition Core”, 2013-2024

National Institutes of Health/NHLBI, 1P01-HL114471-01A1, Leader of Core C “Administrative Core”, 2013-2024

#### **CURRENT - CO-INVESTIGATOR**

National Institutes of Health/NHLBI, U01HL150852, “Rutgers Optimizes Innovation” (ROI), Contact PI, 2019-2023, Total Funding \$999,999 Direct Year 1

National Institutes of Health, 5R01-HL058506, “G Protein-Coupled Receptor Signaling in Airway Smooth Muscle,” PI of Subcontract (PI: Dr. Raymond Penn, Thomas Jefferson University), 2013-2022, \$39,750

National Institutes of Health/NHLBI, R01-HL133433-01A1 “CEBPD-Medicated Mechanisms of Glucocorticoid Insensitivity in Severe Asthma”, PI of Subcontract (PI:Himes, University of Pennsylvania), 2017-2022, \$596,250

National Institutes of Health, R01-HL109557-06A1, “Mechanisms and Consequences of Gene Induction by Glucocorticoids in Airway Smooth Muscle”, PI of Subcontract (PI: Gerber, National Jewish Health), 2017-2021, \$25,000

National Institutes of Health, R01HL111541-07A1, “Airway Inflammatory Pathways Regulating Glucocorticoid Receptor Phosphorylation”, Co-PI (PI: Tliba, Long Island University), 2018-2022, \$437,663

National Institutes of Health/National Institute on Aging, 1R01AG061092, “Strengthening the Evidence Base for Drug Disease Interactions in Older Adults”, Co-PI (PI: Gerhard), 2019-2024, \$499,952

National Institutes of Health/NHLBI, R56HL139564, “Nitric oxide induced soluble guanylate cyclase dysfunction or activation: implications as disease biomarkers or in therapy”, PI of Subcontract (PI: Ghosh, Cleveland clinic Lerner College of Medicine), 2019-2024, \$13,999 Direct Year 1

National Institutes of Health, R01AI143985, “Regulation of FceRI Function by the MS4A Gene Cluster”, PI of Subcontract (PI: Cruse, NC State University), 2019-2024, \$10,000 Direct Year 1

#### **PAST – PRINCIPAL INVESTIGATOR**

National Institutes of Health Trainee Grant, University of Pennsylvania Medical School, 50T35-HD-0721701A1, 1987-89

Parker B. Francis Foundation Award, 1989-91, \$31,000 per year

Schering Research Grant, 1989-90, \$6,000

Clinical Investigator Award, 1-K08-HL02647-01, 1991-96, total costs \$402,000

American Lung Association Research Grant, 1990-92, \$17,500 per year

Merck Pharmaceuticals Research Grant, 1991, \$12,500

University of Pennsylvania Research Foundation, 1992, \$4,000

American Lung Association Research Grant, 1993-94, \$17,500

SmithKline Beecham Research Grant, 1994-95, \$48,500

Abbott Laboratories Research Grant, "Asthma Disease State Management Within an Integrated Health System," 1995-98, \$75,000 (TDC)

SmithKline Beecham Pharmaceuticals, "The Effects of LTD<sub>4</sub> on Expression of Glycosaminoglycans in Human Airway Smooth Muscle," 1996-98, \$32,000 per year

National Aeronautics & Space Administration, NRA-94-OLMSA-02, Principal Investigator, Project 3, "Airway Smooth Muscle and Bone Signal Transduction," 1995-99, \$185,937 per year

American Lung Association Career Investigator Award, "Molecular Mechanisms Regulating Human Airway Smooth Muscle Cell Growth," 1996-99, \$35,000 per year

National Institutes of Health (NHLBI), R01-HL55301, "Cellular and Molecular Mechanisms Regulating Airway Muscle Growth," Principal Investigator, 1996-2000, \$531,216 (TDC)

Merck & Co., "LTD<sub>4</sub> Receptor Expression in Human Airway Smooth Muscle," Principal Investigator, 2001-2002, 2% Effort, \$45,000 Annual Direct Costs

National Institutes of Health, 1R01-HL64063, "Molecular Mechanisms Regulating Synthetic Functions of Human Airway Smooth Muscle," Principal Investigator, 1999-2004, \$225,000 per year

Mind Brain Body & Health Initiative, "Effect of Expectancy on Salmeterol Reversal of Methacholine-Induced Airway Obstruction in Asthma," Principal Investigator, 5/23/2003-12/31/2004, \$62,893

National Institutes of Health (NHLBI), 2R01-HL55301, "Cellular and Molecular Mechanisms Regulating Airway Muscle Growth," Principal Investigator, 2000-2005, \$875,000 (TDC)

National Institutes of Health, P50-HL067663, "Airway Smooth Muscle Modulates Inflammatory Responses in Asthma," Program Director, 2001-2010, 0.12 Calendar Effort, \$1,690,905 Annual Direct Costs

Project 1, "Cellular and Molecular Mechanisms Regulating Synthetic Responses of Human Airway Smooth Muscle," Principal Investigator, \$268,446 Annual Direct Costs

Core A, "Murine Studies," Core Director, \$84,326 Annual Direct Costs

Core C, "Administration," Core Director, \$86,852 Annual Direct Costs

National Institutes of Health, 2R01-HL064063, "Mechanisms Regulating Functions of Airway Smooth Muscle," Principal Investigator, 2004-2010, 0.06 Calendar Effort, \$225,000 Annual Direct Costs

National Institutes of Health, R01-HL080676-01 (RFA HL-04-029), "Ozone Alters Airway Smooth Muscle Function in Asthma," Principal Investigator, 2005-2011, 0.94 Calendar Effort, \$300,000 Annual Direct Costs

National Institutes of Health, R01-HL081824, "Interferons Modulate Airway Smooth Muscle Growth," Principal Investigator, 2005-2011, 1.34 Calendar Effort, \$325,000 Annual Direct Costs

National Institutes of Health, R01-HL077735, "Mechanisms of VEGF Modulation of Smooth Muscle Function," Principal Investigator, 2006-2011, 0.48 Calendar Effort, \$225,000 Annual Direct Costs

National Institutes of Health/NHLBI, 1R01-HL097796-01, RFA-HL-09-007, "RGS: A Molecular Switch Regulating Irreversible ASM Growth/Contraction in Asthma," PI/Program Director, 2009-2014, 1.70 Calendar Effort, \$380,000 Annual Direct Costs

**PAST CO-INVESTIGATOR:**

National Institutes of Health, U01AI122285-S1, "NIAID Extension of Investigator-Initiated Clinical Trials-COVID-19 Supplement", MPI (PI: Blaser, Rutgers University), 2020-2021, \$871,444 Direct Year 1

Subcontract to Project #5, "Resistance of the Cell to Shape Distortion: Microstructural Basis of Cytoskeletal Mechanics," Program Project P01-HL33009, "Physical Determinants of Lung Parenchymal Function," Harvard University School of Public Health, Physiology Program, Dr. Jeffrey Fredberg, PI, 1995-99, 5% Effort, \$15,000

Agency for Health Care Policy and Research, R01-HS10044, "Costs and Effects of Disease Management for Adult Asthma," Co-Investigator with Dr. Alan Hillman, PI, 1999-2000, \$538,725 (TDC)

National Institutes of Health, R01-AI-HL40203, "The IGF Axis in Asthma," Collaborator with Dr. Pinchas Cohen, PI, 1998-2003, \$223,611 (TC for five years)

National Institutes of Health, R01-HL64042, "Adhesion Molecules in Smooth Muscle Activation and Growth," Co-Investigator (Dr. Aili Lazaar, PI), 2000-2005, 10% Effort, \$200,000 Annual Direct Costs

Subcontract to Project #2, "Cytokines Modulate Airway Smooth Muscle Contraction," Program Project P50-HL56383, Harvard University School of Public Health, 2001-2006, 6% Effort, \$32,431 per year (TDC)

National Institutes of Health, P50 67664, "Cytokines, Asthma and Airway Smooth Muscle," Co-Investigator, Subcontract to Project 3 (Dr. J.P. Kinet, PI, Harvard University), 2001-2006, 6% Effort, \$59,403 Annual Direct Costs

National Institutes of Health, U54-RR023567, Clinical and Translational Science Award, Associate Program Director, General Clinical Research Center (PI: Dr. Garret FitzGerald, University of Pennsylvania), 2006-2011, 0.6 Calendar Effort, \$9,541,367 Direct Costs

National Institutes of Health, 2R01-HL071106, "Role of p70 S6 Kinase in Regulating LAM Cell Growth," Co-Investigator (PI: Dr. Vera Krymskaya, University of Pennsylvania), 2007-2012, 0.54 Calendar Effort, \$175,000 Annual Direct Costs

National Institutes of Health, R01-AI06887, "Leukotrienes and Lung Inflammation," PI of Subcontract (PI: Dr. Roy Soberman, Harvard University), 2007-2012, 0.37 Calendar Effort, \$250,000 Annual Direct Costs

National Institutes of Health Challenge Grant, 1RC1 ES018505, "Effects of Ozone Exposure on Expression and Function of Surfactant Protein D," Co-Investigator (PI: Dr. Angela Haczku, University of Pennsylvania), 2009-2012, 0.29 Calendar Effort, \$350,000 Annual Direct Costs

National Institutes of Health, R01-HL085774, "G Protein-Coupled Receptor Signaling in Mast Cells," Co-Investigator (PI: Dr. Hydar Ali, University of Pennsylvania), 2009-2012, 0.11 Calendar Effort, \$250,000 Annual Direct Costs

National Institutes of Health, 1R21-AI094896, "Human Mast Cell MrgX1 and MrgX2 G-Protein Coupled Receptors in Asthma," Co-Investigator (PI: Dr. Hydar Ali, University of Pennsylvania), 2011-2013, 0.60 Calendar Effort, \$42,113

National Institutes of Health, 1R01 AI072197, "Mechanisms of Social Stress-Enhanced Allergic Airway Response in a Mouse Model," Co-Investigator (PI: Dr. Angela Haczku, University of California, Davis), 2010-2015, 0.37 Calendar Effort, \$253,916 Annual Direct Costs

National Institutes of Health/National Institute of Environmental Health Sciences (NIEHS), 1P30 ES013508, Center of Excellence in Environmental Toxicology, Core Director, Research Core III: Lung Disease and the Environment (Program Director: Dr. Trevor Penning, University of Pennsylvania), 2006-2020, 2.25 Calendar Effort, \$354,752 Annual Direct Costs

National Institutes of Health/NIEHS, U19 ES020676, "The Community Health Assessment of Risks Associated with the Macondo Spill," Project 1 Co-Leader (PI: Dr. Cornelis Elferink, University of Texas Medical Branch), 2013-2016, 0.63 Calendar Effort, \$42,251 Annual Direct Costs

National Institutes of Health/NIEHS, U19 ES020676, "Gulf Coast Health Alliance: Health Risks Related to the Macondo Spill (GC HARMS)," CODC Co-Director (PI: Dr. Cornelis Elferink, University of Texas Medical Branch), 2013-2016, 0.18 Calendar Effort, \$39,851 Annual Direct Costs

National Institutes of Health, 1R21-AI108585-01A1, "Human Mast Cell-Specific Mas-Related Gene-X2 (MrgX2) in Anaphylaxis and Asthma," Co-Investigator (PI: Dr. Hydar Ali, University of Pennsylvania Dental School), 2014-2016, 0.45 Calendar Effort, \$180,000 Annual Direct Costs

National Institutes of Health, 1U01-HL110942, "Epigenetic Regulation of Lung Progenitor Repair and Regeneration," Co-Investigator (PI: Dr. Edward Morrisey, University of Pennsylvania), 2012-2016, 0.45 Calendar Effort, \$114,000

National Institutes of Health/NHLBI, 1R01-HL110551-01A1, "Role of Folliculin (FLCN) in Lung Cell Survival," Co-Investigator (PI: Dr. Vera Krymskaya, University of Pennsylvania), 2012-2016, 0.45 Calendar Effort, \$344,254

National Institutes of Health, 1R01-HL116916, "Prevention and Management of Pulmonary Embolism," Co-Investigator (PI: Dr. Douglas Cines, University of Pennsylvania), 2013-2017, 0.45 Calendar Effort, \$254,065 Annual Direct Costs

National Institute of Biomedical Imaging and Bioengineering, R21-EB024081-01, subcontract (UCLA) "Force Phenotyping of Airway Smooth Muscle Cells to Develop Novel Asthma Therapies", Co-PI, 2017-2019, \$218,624

National Institutes of Health/NHLBI, 2R44HL 104902-02A1 "Novel ROCK Inhibitors for COPD", Co-Investigator (PI: Theratropix), 2015-2017, \$288,000

National Institutes of Health/National Institute of Environmental Health Sciences (NIEHS), 1P30 ES013508, Center of Excellence in Environmental Toxicology, Core Director, Research Core III: Lung Disease and the Environment (Program Director: Dr. Trevor Penning, University of Pennsylvania), 2006-2020, \$354,752

National Institutes of Health/NHLBI, 2P01-HL081064-06A1, "Pathobiology of Asthma," PI of Subcontract (PI: Erzurum, Cleveland Clinic Lerner College of Medicine-CWRU), 2015-2020, \$73,080

National Institutes of Health/NHLBI, 1R44-HL132721-02, "Development of an Oral Acidic Mammalian Chitinase Inhibitor to Treat Asthma", Co-Investigator (PI-Oncoarendi), 2018-2020, \$320,000

## PENDING

National Institutes of Health, "Nitric oxide induced soluble guanylate cyclase dysfunction or activation: Implications as disease biomarkers or in therapy", PI of subcontract, 2019-2024, \$13,999 year 1 direct costs.

## PUBLICATIONS:

### A. Refereed Original Article in Journal

1. Mozersky, S., **Panettieri, R.A., Jr.**: Is pH drop a valid measure of extent of protein hydrolysis? *Journal of Agriculture and Food Chemistry*, Nov.-Dec., 1313-1316, 1983. <https://doi.org/10.1021/jf00120a041>
2. Kelley, M.A., **Panettieri, R.A., Jr.**, Krupinski, A.V.: Resting single-breath diffusing capacity as a screening test for exercise-induced hypoxemia. *Am. J. Med.* 80(5):807-812, 1986 (PMID: 3706368).
3. **Panettieri, R.A., Jr.**, Murray, R.K., DePalo, L.R., Yadvish, P.A., Kotlikoff, M.I.: A human airway smooth muscle cell line that retains physiological responsiveness. *Am. J. Physiol. Cell Physiol.* 256:C329-C335, 1989 (PMID: 2645779).
4. **Panettieri, R.A., Jr.**, Yadvish, P.A., Kelly, A.M., Rubinstein, N.A., Kotlikoff, M.I.: Histamine stimulates proliferation of airway smooth muscle and induces c-fos expression. *Am. J. Physiol. Lung Cell. Mol. Physiol.* 259: L365-L371, 1990 (PMID: 2124421).
5. Kelly, A.M., Rosser, B.W.C., Hoffman, R., **Panettieri, R.A., Jr.**, Schiaffino, S., Rubinstein, N.A., Nemeth, P.M.: Metabolic and contractile protein expression in developing rat diaphragm muscle. *J. Neuroscience* 11(5):1231-1242, 1991 (PMID: 2027044).
6. Stedman, H.H., Sweeney, H.L., Shrager, J.B., Maguire, H.C., **Panettieri, R.A., Jr.**, Petrof, B., Narusawa, M., Leferovich, J.M., Sladky, J.T., Kelly, A.M.: The mdx mouse diaphragm reproduces the degenerative changes of Duchene muscular dystrophy. *Nature* 352:536-539, 1991 (PMID: 1865908).

7. Munoz, N.M., Zak, R., **Panettieri, R.A., Jr.**, Wiesner, R., Leff, A.R.: Changes in levels of mRNA encoding myosin heavy chain in porcine trachealis during ontogenesis. Am. J. Respir. Cell Mol. Biol. 8:252-257, 1993 (PMID: 8448016).
8. Hershenson, M.B., Kelleher, M.D., Naureckas, E.T., Abe, M.K., Rubinstein, V.J., Zimmermann, A., Bendele, A.M., McNulty, J.A., **Panettieri, R.A., Jr.**, Solway, J.: Hyperoxia increases airway cell S-phase traversal in immature rats in vivo. Am. J. Respir. Cell Mol. Biol. 11:296-303, 1994 (PMID: 8086167).
9. Pilewski, J.M., **Panettieri, R.A., Jr.**, Kaiser, L.R., Albelda, S.M.: Expression of endothelial cell adhesion molecules in human bronchial xenographs. Am. J. Respir. Crit. Care Med. 150:795-801, 1994 (PMID: 7522102).
10. Lazaar, A.L., Albelda, S.M., Pilewski, J.M., Brennan, B., Puré, E., **Panettieri, R.A., Jr.**: T lymphocytes adhere to airway smooth muscle cells via integrins and CD44 and induce smooth muscle cell DNA synthesis. J. Exp. Med. 180:807-816, 1994 (PMID: 7520473).
11. Puré, E., Camp, R.L., Peritt, D., **Panettieri, R.A., Jr.**, Lazaar, A.L., Nayak, S.: Defective phosphorylation and hyaluronate binding of CD44 with point mutations in the cytoplasmic domain. J. Exp. Med. 181:55-62, 1995 (PMID: 7528778).
12. **Panettieri, R.A., Jr.**, Murray, R.K., Bilgen, G., Eszterhas, A.J., Martin, J.G.: Repeated allergen inhalations induce DNA synthesis in airway smooth muscle and epithelial cells in vivo. Chest 107(3) Supplement: 94S-95S, 1995 (PMID: 7875013).
13. Einarsson, O., Geba, G.P., Zhou, Z., Landry, M.L., **Panettieri, R.A., Jr.**, Tristram, D., Welliver, R., Metinko, A., Elias, J.A.: Interleukin-11 in respiratory inflammation, in Mackiewicz, A., Koj, A., Sehgal, P.B. (Eds.) Interleukin-6-Type Cytokines. Ann. N.Y. Acad. Sci. 762:89-101, 1995 (PMID: 7668577).
14. **Panettieri, R.A., Jr.**, Hall, I.P., Maki, C.S., Murray, R.K.:  $\alpha$ -Thrombin increases cytosolic calcium and induces human airway smooth muscle cell proliferation. Am. J. Respir. Cell Mol. Biol. 13:205-216, 1995 (PMID: 7626288).
15. **Panettieri, R.A., Jr.**, Lazaar, A.L., Puré, E., Albelda, S.M.: Activation of cAMP-dependent pathways in human airway smooth muscle cells inhibits TNF- $\alpha$ -induced ICAM-1 and VCAM-1 expression and T lymphocyte adhesion. J. Immunol. 154:2358-2365, 1995 (PMID: 7532667).
16. Amrani, Y., **Panettieri, R.A., Jr.**, Frossard, N., Bronner, C.: Activation of the TNF $\alpha$ -p55 receptor induces myocyte proliferation and modulates agonist-evoked calcium transients in cultured human tracheal smooth muscle cells. Am. J. Respir. Cell Mol. Biol. 15:55-63, 1996 (PMID: 8679222).
17. **Panettieri, R.A., Jr.**, Goldie, R.G., Rigby, P., Eszterhas, A.J., Hay, D.W.P.: Endothelin-1-induced potentiation of human airway smooth muscle proliferation: an ET<sub>A</sub> receptor-mediated phenomenon. Br. J. Pharmacol. 118:191-197, 1996 (PMID: 8733595).
18. Hubmayr, R.D., Shore, S.A., Fredberg, J.J., Planus, E., **Panettieri, R.A., Jr.**, Moller, W., Heyder, J., Wang, N.: Pharmacological activation changes stiffness of cultured human airway smooth muscle cells. Am. J. Physiol. Cell Physiol. 271:C1660-C1668, 1996 (PMID: 8944650).
19. Lazaar, A.L., Reitz, H.E., **Panettieri, R.A., Jr.**, Peters, S.P., Puré, E.: Antigen receptor-stimulated peripheral blood and bronchoalveolar lavage-derived T cells induce MHC class II and ICAM-1 expression on human airway smooth muscle. Am. J. Respir. Cell Mol. Biol. 16:38-45, 1997 (PMID: 8998077).
20. Cohen, M.D., Ciocca, V., **Panettieri, R.A., Jr.**: TGF- $\beta$ 1 modulates human airway smooth muscle cell proliferation induced by mitogens. Am. J. Respir. Cell Mol. Biol. 16:85-90, 1997 (PMID: 8998083).
21. Shore, S.A., Laporte, J., Hall, I.P., Hardy, E., **Panettieri, R.A., Jr.**: Effect of IL-1 $\beta$  on responses of cultured human airway smooth muscle cells to bronchodilator agonists. Am. J. Respir. Cell Mol. Biol. 16:702-712, 1997 (PMID: 9191472).
22. Elias, J.A., Wu, Y., Zheng, T., **Panettieri, R.A., Jr.**: Cytokine- and virus-stimulated airway smooth muscle cells produce IL-11 and other IL-6-type cytokines. Am. J. Physiol. Lung Cell. Mol. Physiol. 273: L648-L655, 1997 (PMID: 9316501).
23. Amrani, Y., Krymskaya, V., Maki, C., **Panettieri, R.A., Jr.**: Mechanisms underlying TNF $\alpha$  effects on agonist-mediated calcium homeostasis in human airway smooth muscle cells. Am. J. Physiol. Lung Cell. Mol. Physiol. 273: L1020-L1028, 1997 (PMID: 9374730).
24. Krymskaya, V.P., Hoffman, R., Eszterhas, A., Ciocca, V., **Panettieri, R.A., Jr.**: TGF $\beta$ 1 modulates EGF-stimulated phosphatidylinositol 3-kinase activity in human airway smooth muscle cells. Am. J. Physiol. Lung Cell. Mol. Physiol. 273: L1220-L1227, 1997 (PMID: 9435577).
25. Gurubhagavatula, I., Amrani, Y., Pratico, D., Ruberg, F.L., Albelda, S.M., **Panettieri, R.A., Jr.**: Engagement of human PECAM-1 (CD31) on human endothelial cells increases intracellular calcium

- ion concentration and stimulates prostacyclin release. *J. Clin. Invest.* 101:212-222, 1998 (PMID: 9421484).
- 26. **Panettieri, R.A., Jr.**, Murray, R.K., Eszterhas, A.J., Bilgen, G., Martin, J.G.: Repeated allergen inhalations induce DNA synthesis in airway smooth muscle and epithelial cells in vivo. *Am. J. Physiol. Lung Cell. Mol. Physiol.* 274: L417-L424, 1998 (PMID: 9530178).
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**C. Patents Pending**

- Compositions and Methods Targeting G12 Signaling for Bronchodilator Therapy (Docket No. 5431.1001.000, international application US2018/037773)
- Antithrombin Agents in the Treatment of Asthma (Penn G1161)
- Surfactant Protein D Is a Biomarker for Steroid Resistance in Asthma and Chronic Obstructive Pulmonary Disease (Docket No. 046483-5121-P1-US, DBR #402201)
- Compositions and Methods for Treating Asthma and Other Lung Diseases, US Patent Office Application No. 13/256,560, International Application No. PCT/US10/27833, Atty. Docket No. P-71417-USP (Prior Application No. 61/161,305), Publication no. US-2018-0071233-A1

**D. Other Articles (Reviews, Editorials, etc.)**

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#### E. Abstracts

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- 287.Koziol-White, C., Zhang, J., Dainty, I., Miller-Larsson, A., **Panettieri, R.A., Jr.**: A brief budesonide pretreatment has little effect on carbachol-induced bronchoconstriction, but significantly augments formoterol-induced bronchodilation of human small airways. Am. J. Respir. Crit. Care Med. 191: A4118, 2015.
- 288.Koziol-White, C., Johnson, M., Filer, A., Ryan, M., **Panettieri, R.A., Jr.**: CCL17 augments contractility and contractile pathways in human small airways and airway smooth muscle (ASM). Am. J. Respir. Crit. Care Med. 191: A5187, 2015.

- 289.Jude, J.A., Ojiaku, C.A., Koziol-White, C., Jester, W., Cao, G., **Panettieri, R.A., Jr.**: Cigarette smoke enhances carbachol-induced airway narrowing in human precision-cut human lung slices (hPCLS). Am. J. Respir. Crit. Care Med. 191: A5002, 2015.
- 290.Ojiaku, C.A., Jude, J.A., **Panettieri, R.A., Jr.**: The role of NADPH oxidase isoforms and reactive oxygen species in human airway smooth muscle cell (HASMC) function. Am. J. Respir. Crit. Care Med. 191: A3526, 2015.
- 291.Jiang, Z., Kokalari, B., Koziol-White, C., Jester, W., **Panettieri, R.A., Jr.**, Haczka, A.: 20-hydroxyeicosatetraenoic acid (20-HETE) induces airway inflammation and hyperresponsiveness in mice. Am. J. Respir. Crit. Care Med. 191: A5165, 2015.
- 292.An, S., Tang, W.Y., Ahn, K., Mitzner, W., Huang, J., Kumar, S., Biswal, S., **Panettieri, R.A., Jr.**, Solway, J., Liggett, S.B.: Inflammation-independent regulation of airway smooth muscle mechanical properties in asthma. Am. J. Respir. Crit. Care Med. 191: A2466, 2015.
- 293.Himes, B.E., Koziol-White, C.J., Nikolos, C., Jester, W., Johnson, M., Klanderman, B., Litonjua, A.A., Tantisira, K.G., Truskowski, K., MacDonald, K., **Panettieri, R.A., Jr.**, Weiss, S.T.: Vitamin D modulates expression of the airway smooth muscle transcriptome in fatal asthma. Am. J. Respir. Crit. Care Med. 191: A2471, 2015.
- 294.Gupta, M.K., Asosingh, K., Aronica, M., Comhair, S.A.A., Erzurum, S.C., **Panettieri, R.A., Jr.**, Naga Prasad, S.V.: Loss of beta-adrenergic receptor resensitization in human airway smooth muscle cells from asthmatic patients. Am. J. Respir. Crit. Care Med. 191: A3536, 2015.
- 295.Huang, J., Aisenberg, W., Cruz, R., Natarajan, N., Oh, J.J., Yong, H.M., **Panettieri, R.A., Jr.**, Liggett, S.B., Pluznick, J.L., An, S.S.: Functional expression of the olfactory signaling system in human airway smooth muscle. Am. J. Respir. Crit. Care Med. 191: A5594, 2015.
- 296.Bozik, M.E., Hebrank, G.T., Lee, S., Ferguson, B.J., Mather, J., Sullivan, M.S., Archibald, D., **Panettieri, R.A., Jr.**, Dworetzky, S.I.: Dexmedetomidine for the treatment of chronic rhinosinusitis with nasal polyps: preliminary findings in an open-label proof of concept trial. International Eosinophil Society 9<sup>th</sup> Biennial Symposium, Chicago, IL, July 20 2015.
- 297.Koziol-White, C.J., Zhang, J., Miller-Larsson, A., Dainty, I., **Panettieri, R.A., Jr.**: Budesonide augments formoterol-induced bronchodilation of human small airways within minutes. Presented at the European Respiratory Society 2015 International Congress, Amsterdam, The Netherlands, September 2015.
- 298.Velalopoulou, A., Pietrofesa, R., Verginadis, I., Koziol-White, C., **Panettieri, R.A., Jr.**, Tuttle, S., Berman, A., Koumenis, C., Christofidou-Solomidou, M.: Novel synthetic secosolanicarecinol diglucoside (SDG) protects precision-cut human lung slices (huPCLS) from proton radiation damage. Radiation Research Annual Meeting, September 2015.
- 299.**Panettieri, R.A., Jr.**, Corren, J., Gabriel, S., Ruiz, K.M., Sawchyn, B., Colby, J.A., Mendelson, M.: Reduction in corticosteroid use among patients receiving omalizumab in real world settings: a systematic literature review of non-randomized studies. Poster Presentation at AAAAI Annual Meeting, Los Angeles, CA, March 2016.
- 300.Vegesna, A.V., **Panettieri, R.A., Jr.**, Gabriel, S., Ruiz, K.M., Colby, J.A., Maiese, B., Corren, J.: Patient-reported outcomes (PROs) in patients receiving omalizumab (OMB): a systematic literature review. Poster Presentation, AAAAI Annual Meeting, Los Angeles, CA, March 2016.
- 301.Vos, W., Van Holsbeke, C., Ferreira, F., Nuytten, L., Chipps, B., **Panettieri, R.A., Jr.**, Lieberman, P., De Backer, J.: Assessment of lung deposition of MEDA Aerospan versus GSK Flovent in a population of asthma patients. Poster Presentation at AAAAI Annual Meeting, Los Angeles, CA, March 2016.
- 302.Koziol-White, C., Zhang, J., Yoo, E., Charron, C., Stevenson, C., **Panettieri, R.A., Jr.**: A narrow spectrum kinase inhibitor, RV1729, induces bronchodilation of human small airways and rescues agonist-induced desensitization of the  $\beta_2$  adrenoceptor ( $\beta_2$ AR). Poster Presentation at the American Thoracic Society International Conference, San Francisco, CA, May 2016.
- 303.Ojiaku, C.A., Cao, G., Zhu, W., An, S.S., **Panettieri, R.A., Jr.**: TGF- $\beta$ 1 evokes human airway smooth muscle shortening and hyperresponsiveness: a new job description? Poster presentation at the American Thoracic Society International Conference, San Francisco, CA, May 2016.
- 304.Yoo, E., Vivieros, J., Sidoli, S., Cao, G., Garcia, B.A., **Panettieri, R.A., Jr.**: Elevated histone H3K27 methylation mediates intrinsic hypercontractility in human airway smooth muscle cells from fatal asthma subjects. Poster Presentation at the American Thoracic Society International Conference, San Francisco, CA, May 2016.
- 305.Himes, B.E., Koziol-White, C., Johnson, M., Jester, W., **Panettieri, R.A., Jr.**: SOCS1 and SOC3 modulate immune response in the airway smooth muscle. Poster Presentation at the American Thoracic Society International Conference, San Francisco, CA, May 2016.

- 306.Gerber, A.N., Kadiyala, V., **Panettieri, R.A., Jr.**, Sasse, S.: Novel mechanisms of steroid function in airway smooth muscle defined through ChIP-seq. Poster Presentation at the American Thoracic Society International Conference, San Francisco, CA, May 2016.
- 307.Toews, M., Schulte, N., Tu, Y., **Panettieri, R.**, Romberger, D., Tian, G. The ProS peptide of porcine cathelicidins is an active component of swine concentrate animal feeding operations (CAFOs) dust that mobilizes calcium and stimulates proliferation in human airway smooth muscle cells. Experimental Biology, Chicago, IL, April 2017.
- 308.Winterbottom, C., Shah, R., Patterson, K., Kreider, M., **Panettieri, R.**, Rivera-Lebron, B., Kawut, S., Miller, W., Litzky, LA., Penning, T., Heinlen, K., Jackson, T., Localio, AR., Christie, J. Exposure to ambient particulate matter is associated with accelerated functional decline in idiopathic pulmonary fibrosis. CHEST, Toronto, Ontario, Canada, October 2017
- 309.Tian, G., Schulte, NA., Krymskaya, VP., **Panettieri, R.**, Zheng, J., Huang, Y., Toews, ML. Effects of culture medium and glutaminase inhibition on proliferation of normal human airway smooth muscle cells and pulmonary LAM patient-derived cells. American Thoracic Society, Washington, DC., May 2017
- 310.Ojiaku CA, Cao G, Zhu W, An SS, **Panettieri RA Jr.** TGF- $\beta$ 1 Induces Human Airway Smooth Muscle Cell Shortening and Airway Hyperresponsiveness Through a Smad3-dependent Pathway. American Thoracic Society, Washington, DC, May 2017
- 311.Jude J, Soliman F, Botelho D, Jester W, **Panettieri RA Jr.** Toxicant 2,4-dinitro-1-chlorobenzene (DNCB) modulates pro-contractile signaling in human airway smooth muscle (HASM) cells. American Thoracic Society, Washington, DC, May 2017
- 312.Koziol-White CJ, Nezgoverova V, Cohn L, Chupp G, **Panettieri RA Jr.** Blocking YKL-40 (chitinase-like protein chitinase 3) attenuates IL-13-induced airway hyperresponsiveness in a human precision cut lung slice model. American Thoracic Society, Washington, DC, May 2017
- 313.Koziol-White CJ, Patel R, Corbi C, Lo D, Parikh V, Karmacharya N, Liggett S, **Panettieri RA Jr.** Rhinovirus strains differentially affect airway hyper-reactivity (AHR) in model of human precision cut lung slices (hPCLS). American Thoracic Society, Washington, DC, May 2017
- 314.Gupta, MK., Cao, G., Harford, T., Peidemonte, G., **Panettieri, RA Jr.**, Erzurum, SC., Prasad, SVN. TNF- $\alpha$ -Nitric Oxide (NO) axis mediated  $\beta$ -adrenergic receptor dysfunction in human airway smooth muscle cells. Experimental Biology, Chicago, IL, April 2017
- 315.Ke X, Kavati A, Wertz D, Huang Q, Wang L, Willey VJ, Stephenson JJ, Ortiz B, **Panettieri RA Jr.**, Corren J. Real-world Clinical Characteristics, Treatment Patterns, and Exacerbations in Asthma Patients Newly Treated with Omalizumab in the United States. American College of Allergy, Asthma, and Immunology Annual Scientific Meeting, Boston, MA, October 2017.
- 316.Ke X, Kavati A, Wertz D, Huang Q, Wang L, Willey VJ, Stephenson JJ, Ortiz B, **Panettieri RA Jr.**, Corren J. A Real-world Assessment of Omalizumab Treatment Patterns in Asthma Patients Newly Treated with Omalizumab. Poster presentation at the American College of Allergy, Asthma, and Immunology Annual Scientific Meeting, Boston, MA, October 2017.
- 317.Ke X, Kavati A, Wertz D, Huang Q, Wang L, Willey VJ, Stephenson JJ, Ortiz B, **Panettieri RA Jr.**, Corren J. A Real-world Assessment of Asthma Exacerbations in Asthma Patients Newly Treated with Omalizumab. Poster presentation at the American College of Allergy, Asthma, and Immunology Annual Scientific Meeting, Boston, MA, October 2017.
- 318.**Panettieri RA Jr.**, Sjoberg U, Peterffy A, Wessman P, Bowen K, Piper E, Colice G, Brightling CE. Efficacy and Safety of Tralokinumab in Two Phase III Trials of Severe, Uncontrolled Asthma. American Thoracic Society, San Diego, CA, May 2018.
- 319.Soong W, Carr W, Chipps BE, Ledford DK, Lugogo N, Moore WC, **Panettieri RA Jr.**, Trevor J, Belton L, Trudeau F, Ambrose CS. Demographic Characteristics, Comorbidities, and Exacerbation Frequency Among Patients Enrolled in the CHRONICLE Study: A Real-world, Prospective, Observational Study of US, Subspecialist-treated Adults with Severe Asthma. American Academy of Allergy, Asthma and Immunology. San Francisco, February 2019.
- 320.Soong W, Carr W, Chipps BE, Ledford DK, Lugogo N, Moore WC, **Panettieri RA Jr.**, Trevor J, Belton L, Trudeau F, Ambrose CS. Characteristics by Provider Subspecialty of Patients Enrolled in the CHRONICLE Study: A Real-world, Prospective, Observational Study of US, Subspecialist-Treated Adults with Severe Asthma. American Academy of Allergy, Asthma and Immunology. San Francisco, February 2019.
- 321.Carr W, Lugogo N, Moore WC, **Panettieri RA Jr.**, Soong W, Trudeau F, Ambrose CS. High Burden of Exacerbations of Severe Asthma: Results from a Real-World Study of Patients Treated by Subspecialists in the United States, February 2019.

322. **Panettieri RA Jr.**, Carr W, Chipps BE, Ledford DK, Lugogo N, Moore WC, Soong W, Trevor J, Belton L, Trudo F, Ambrose CS. Characteristics by Provider Subspecialty of Patients Enrolled in the CHRONICLE Study: A Real-World Prospective, Observational Study of U.S., Subspecialist-Treated Adults with Severe Asthma. Dallas, May 2019.
323. Moore WC, Carr W, Chipps BE, Ledford DK, Lugogo N, **Panettieri RA Jr.**, Soong W, Trevor J, Belton L, Trudo F, Ambrose CS. Real-world Biologic Medication Use in a Diverse Population of U.S., Specialist-treated Adults With Severe Asthma: Results of the Chronicle Study. Dallas, May 2019.
324. Ambrose CS, Carr W, Chipps BE, Ledford DK, Lugogo N, Moore WC, Soong W, Trevor J, **Panettieri RA Jr.**, Belton L, Trudo F. "Characteristics of U.S.; Subspecialist-treated Adults with Severe Asthma Receiving and Not Receiving Therapy with Biologic Medications in the CHRONICLE Study. Dallas, May 2019.
325. Wechsler M, Peters S, Chipps B, Hill T, Ariely R, Depietro M, Terasawa E, Thomason D, **Panettieri RA Jr.**. Real-world evidence of reductions in health resource utilization (HRU) and improved efficacy outcomes associated with reslizumab treatment in adults with severe eosinophilic asthma (SEA) in the United States, March 2020.
326. Wechsler M, Chipps B, Hill T, Ariely R, Depietro M, Terasawa E, Thomason D, **Panettieri RA Jr.**. Real-world evidence of improved patient outcomes with reslizumab in adults with severe eosinophilic asthma (SEA): Subgroup analyses of patients using maintenance oral corticosteroids (OCS) prior to treatment initiation, March 2020.
327. Soong W, Ambrose C, Trevor J, Lugogo N, Desai P, Moore W, Trudo F, **Panettieri RA Jr.**. Real-World Asthma Exacerbation and Hospitalization Rates by Treatment Among Specialist-Treated United States Severe Asthma Patients. ACAAI 2020, Virtual ePoster Presentation November 2020.
328. Ambrose C, Lugogo N, **Panettieri RA Jr.**, Soong W, Trevor J, Moore W, Desai P, Trudo F. Real-World Burden of Specialist-Treated Severe Asthma by Blood Eosinophil Count and Total Immunoglobulin E Level. ACAAI 2020, Virtual ePoster Presentation, November 2020.
329. Hanania NA, Maspero J, **Panettieri RA Jr.**, Catro M, Daizadeh N, Djandji Michel, Ortiz B, Rowe P, Deniz Y. Effect Of Dupilumab On Severe Exacerbations In Asthma Patients With And Without Lung Function Improvements, June 2020.
330. Hanania N.A., Maspero J.F., **Panettieri RA Jr.**, Castro M, Daizadeh N, Djandji M, Ortiz B, Rowe P, Deniz Y. Effect of Dupilumab on Severe Exacerbations in Asthma Patients With and Without Lung Function Improvements. 30<sup>th</sup> International Congress of the European Respiratory Society, Virtual Congress, September 2020.
331. Lugogo N, Carr W, Chipps BE, **Panettieri RA Jr.**, Moore WC, Trudo F, Ambrose CS. Maintenance Systemic Coricosteroid Use is Associated with Multiple Adverse Conditions in U.S Adults with Severe Asthma: Results from the CHRONICLE Study. ATS Journals. 2020
332. Soong W, Ambrose C, Carstens D, Trudo F, Moore W, **Panettieri RA Jr.**. Which Severe Asthma Patients are Switching, Stopping, or Continuing Biologic Treatments? AAAAI March 2021
333. **Panettieri RA, Jr.**, Lugogo N, Moore W.C., Chipps B.E., Soong W, Carstens D, Genofre E, Ambrose C.S. Biologic Medications for Severe Asthma are Effective in the Real-World, Including in Subgroups Not Studied in Randomized Trials. CHEST 2021, Accepted. July 2021
334. **Panettieri, RA Jr.**, Bangalore M, Camargo, C.A., Cheema T, El Bayadi S, Fiel S, Jain R.G., Midwinter D, Rabadi N, Thomashow B, Lipson D.A. Effect of once-daily single-inhaler fluticasone furoate/umeclidinium/vilanterol triple therapy on exacerbations compared with budesonide/formoterol dual therapy in patients with chronic obstructive pulmonary disease and no history of exacerbations: a post hoc analysis of the FULFIL study. CHEST 2021, E-poster, Submitted April 2021
335. **Panettieri, RA Jr.**: Effects of Age of Asthma Onset as a Continuous Variable on Treatment Outcomes. CHEST 2021, E-poster, Submitted April 2021
336. Bleeker E, **Panettieri RA Jr.**, Lugogo N, Corren J, Daizadeh N, Jacob-Nara J, Deniz Y, Rowe P, Khodzhayev A, Ortiz B, Ferro T, Hansen C: Dupilumab Efficacy in Patients With Moderate-to-Severe Type 2 Asthma With and Without Elevated Blood Neutrophils. ATS 2021, Virtual ePoster Presentation May 2021.
337. De La Hoz R, Feldman C, Fennelly K, **Panettieri RA Jr.**, Miller S, Mara L, O'Leary S, Radbel J, Horne D, Castner J. Occupational Covid-19 Exposure: Risks and Mitigation. ATS 2021, Virtual Symposium Presentation, May 2021.
338. **Panettieri RA Jr.**: Demographic Characteristics and Laboratory Biomarker Testing of Patients Receiving Individual Biologic Therapies for Severe Asthma in the United States. ATS 2021, Virtual ePoster Presentation May 2021.

339. Prussin C, **Panettieri RA Jr.**, Bozik ME, Archibald DG, Mather JL, Siddiqui S: Oral Dexamipexole Efficacy in Lowering Blood Eosinophils in Patients with Moderate to Severe Uncontrolled Eosinophilic Asthma. EXHALE (AS2021) ATS 2021, Virtual ePoster Presentation May 2021.
340. Chipps B.E., Soong W, **Panettieri RA Jr.**, Carr W, Cook B, Llanos-Ackert JP, Ambrose CS. Disease Triggers and Associated Quality of Life Among Specialist-Treated US Patients with Severe Asthma. ACAAI 2021 New Orleans, November 2021. Submitted July 2021.
341. Tumminello B, **Panettieri RA Jr.**, EQUIP Interim Results: A Phase 1b Study Evaluating Itolizumab in Subjects with Moderate-to-Severe Uncontrolled Asthma. ACAAI 2021 New Orleans, November 2021. Submitted July 2021.
342. Chipps BE, Elliot I, Beasley R, **Panettieri RA Jr.**, Albers F, Cappelletti C Johnsson E. Efficacy and safety of albuterol/budesonide (PT027) in mild-to-moderate asthma: Results of the DENALI study. ATS 2022, Oral presentation. May 16, 2022.

#### PRESENTATIONS:

- 1988 "Myosin Heavy Chain Regulation in Airway Smooth Muscle," Johns Hopkins University, Baltimore, MD
- 1989 "A Novel Airway Smooth Muscle Cell Mitogen Induces Transcription of c-fos mRNA," University of Chicago, Chicago, IL
- 1990 "Treatment of Severe Asthma," Kaiser-Permanente Medical Corporation, Wash. DC
- 1991 "Airway Smooth Muscle Cell Proliferation: Insights in Cellular and Molecular Mechanisms," Meakins-Christie Laboratories, McGill University, Montreal, Canada
- 1991 "Life-Threatening Asthma," American Lung Association of Delaware
- 1991 "Life-Threatening Asthma," Medical Grand Rounds, Christiana Medical Center, Wilmington, Delaware
- 1992 "Chronic Severe Asthma," Delaware Academy of Physicians Assistants, Wilmington, Delaware
- 1992 "Aspirin Challenge and Desensitization for Asthma," ALA/ATS International Conference, Miami Beach, Florida
- 1993 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Cell Proliferation," Pierce Foundation, New Haven, Connecticut
- 1994 "Airway Smooth Muscle Proliferation," Harvard School of Public Health, Physiology Program, Boston, MA
- 1994 "Cell Proliferation: Molecular and Cellular Mechanisms," McGill University, Montreal, Canada
- 1994 "COPD Revisited," New York State Society of Internal Medicine, Wilmington, Delaware
- 1994 "Chronic Severe Asthma," Grand Rounds, Geisinger Medical Center, Danville, PA
- 1994 NHLBI/NIH Joint USA-Russia Symposium on Vascular Biology and Cellular Differentiation: Molecular Mechanisms Regulating Airway Smooth Muscle Growth, Dallas, TX
- 1995 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Cell Proliferation," Yale University, New Haven, CT
- 1995 "Mechanisms Inducing Airway Smooth Muscle Cell Growth," University of Vermont, Burlington, VT
- 1995 "Update on Asthma Management," Christ Hospital, Jersey City, NJ
- 1995 "Pharmacoeconomic Modeling in Asthma," San Francisco, CA
- 1995 "Effects of Microgravity on Airway Smooth Muscle Cell Proliferation," Houston, TX
- 1995 "Strategies to Enhance Adherence (Compliance)," Symposium on New Horizons in Understanding and Managing Asthma," Atlanta, GA
- 1995 "Update in Asthma Management," The MVP Health Plan Medical Symposium, Lake George, NY
- 1996 "Molecular Mechanisms Regulating Airway Smooth Muscle Cell Growth," New York University, New York
- 1996 "Airway Smooth Muscle Cell Proliferation," Smooth Muscle Heterogeneity Workshop, University of Manitoba, Canada, August
- 1996 "Cytokine Modulation of Smooth Muscle Function," NIH/Russian Scientist Exchange, Samara, Russia, June
- 1996 "Asthma Care in a Medicaid Managed Care Environment," Zitter Group, San Francisco, CA, September
- 1997 "Asthma Update," Polyclinic, Harrisburg, PA
- 1997 "Leukotrienes and Asthma," Grand Rounds, New York Hospital, Flushing, NY
- 1997 "Update on Asthma Management," Grand Rounds, St. Joseph Hosp., Parkersburg, WV
- 1997 "Update on Asthma Management," Shady Side Hospital, Pittsburgh, PA
- 1997 "Pharmacoeconomics of Asthma," Lahey Hitchcock Med. Ctr, Waterville, NH
- 1997 "Asthma Outcomes," Cambridge Health Resources, Seattle, WA
- 1997 "Leukotrienes and Asthma," Pennsylvania Allergy & Asthma Association, Harrisburg, PA
- 1997 "Asthma Disease Management," Pennsylvania Allergy & Asthma Association, Harrisburg, PA

- 1997 "Airway Smooth Muscle: Immunomodulatory Role in Asthma," Research Seminar, Hoffmann-LaRoche Pharmaceuticals, Nutley, NJ
- 1997 "Inflammation and Airway Smooth Muscle," Research Symposium, Centocor, Malvern, PA
- 1997 "Asthma Disease State Management," National Congress of Managed Care, Washington, DC
- 1997 "Airway Smooth Muscle Cell Function in Asthma," 4th Annual Great Lakes Conference, Niagara-on-the-Lake, Ontario, Canada
- 1997 "Pranlukast, but not Montelukast, Inhibits Human Airway Smooth Muscle Cell Proliferation," European Respiratory Society, Berlin, Germany
- 1998 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Cell Proliferation and Cell Adhesion Molecule Expression," Transatlantic Airway Conference, Lucerne, Switzerland
- 1998 "Airway Smooth Muscle Function in Health and Disease," Visiting Professor, Johns Hopkins University, Baltimore, MD
- 1998 "Asthma in the 21st Century," George Washington University, Washington, DC
- 1998 Participant, Global Workshop on Airway Remodeling, Gothenburg, Sweden
- 1998 "Asthma in the Next Millennium," Visiting Professor, University of Mississippi
- 1998 Participant, Consensus Meeting on Airway Remodeling, NIH/NHLBI, Washington, DC
- 1998 "Asthma Update," Grand Rounds, Crozer-Chester Medical Center
- 1998 "Airway Smooth Muscle: Immunomodulatory Role," Visiting Professor, Louisiana State University, Grand Rounds
- 1998 "Airway Smooth Muscle: Immunomodulatory Role," Visiting Professor, University of Miami, Grand Rounds
- 1999 "Airway Smooth Muscle: Immunomodulatory Role," Visiting Professor, Cleveland Clinic
- 1999 "Airway Smooth Muscle: Immunomodulatory Role," Robert E. Cooke Memorial Lecture, AAAAI 55<sup>th</sup> Annual Meeting, Orlando, FL
- 1999 "Airway Remodeling," Visiting Professor, Tufts University, Boston, MA
- 1999 "Airway Smooth Muscle Proliferation: The Signals," Visiting Professor, University of Michigan
- 1999 "Asthma and Airway Remodeling," Visiting Professor, Grand Rounds, University of Tennessee, Memphis, TN
- 1999 "Airway Remodeling: Irreversible?" Visiting Professor, Grand Rounds, University of Arkansas, Little Rock, AR
- 1999 "Immunobiology of Airway Smooth Muscle," Physiology Conference, University of Arkansas, Little Rock, AR
- 1999 "Asthma in the New Millennium," Visiting Professor, Grand Rounds, State University of New York, Stony Brook
- 1999 "Airway Smooth Muscle Growth: The Cellular and Molecular Mechanisms," Visiting Professor, Case Western Reserve University
- 1999 "New Approaches to Asthma Therapy," Visiting Professor, Grand Rounds, Chang Gung Hospital, Taipei, Taiwan
- 1999 Invited Speaker, International Genetics of Asthma Workshop, American Lung Association, Boston, MA
- 1999 Participant, International Conference on Lymphangiomyomatosis, New York, NY
- 1999 "Airway Remodeling: The Therapeutic Approach," Plenary Speaker, American College of Allergy, Asthma and Immunology International Meeting, Chicago, IL
- 2000 "Airway Remodeling," Visiting Professor, Emory University, Atlanta, GA, Visiting Professor, Medical College of Georgia, Augusta, GA
- 2000 "Asthma and Airway Remodeling," Grand Rounds, Visiting Professor, University of Pittsburgh
- 2000 "Asthma Today," Grand Rounds, Ohio State University
- 2000 "Asthma," Visiting Professor, Ellis Hospital, Syracuse, NY
- 2000 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Cell Function," ALA/ATS International Conference Symposium, Toronto, Ontario, Canada (May)
- 2000 "Contribution of Airway Smooth Muscle: Proliferative Mechanisms," World Congress on Lung Health and 10<sup>th</sup> European Respiratory Society Annual Congress, Florence, Italy (August-September)
- 2000 "Airway Remodeling – Therapeutic Approaches," Update in Allergy and Immunology, Nassau County Medical Center, East Meadow, Long Island, NY (October)
- 2000 Visiting Professor, University of Virginia, Charlottesville (October)
- 2000 "Airway Remodeling," Inova Institute 6<sup>th</sup> Annual Pulmonary Review Conference, Falls Church, VA (October)
- 2000 "Airway Smooth Muscle Function in Asthma," Annual Pittsburgh Allergy Meeting, Pittsburgh, PA (October)

- 2000 "Smooth Muscle Function in Asthma," Visiting Professor, Johns Hopkins University, Baltimore, MD, Division of Clinical Immunology (November)
- 2000 "Asthma," Grand Rounds, Franklin Square Hospital, Baltimore, MD (November)
- 2000 "Asthma," Grand Rounds, Delaware County Memorial Hospital, Drexel Hill, PA (November)
- 2000 "Airway Remodeling in Asthma," Asthma Summit 2000, American Lung Association of Mississippi, Jackson, MS (November)
- 2000 "Lung Inflammation and Remodeling," Northeast Pulmonary Teaching Conference, American Lung Association of Central New York, Cornell University, Ithaca, NY (November)
- 2000 "Asthma Update," Grand Rounds, Greater Baltimore Medical Associates Hospital, Baltimore, MD (December)
- 2000 "Asthma Today," St. Joseph's Hospital, Towson, MD (February)
- 2001 "New Therapies in Asthma," Visiting Professor, Seoul National University, Seoul, Korea (February)
- 2001 "Smooth Muscle Function in Asthma," Visiting Professor, Kyungpook National University, Daegu, Korea (February)
- 2001 "Airway Remodeling in Asthma, Visiting Professor, Pusan National University, Pusan, Korea (February)
- 2001 "Smooth Muscle Cells and Airway Remodeling in Asthma," American Academy of Allergy, Asthma and Immunology (AAAAI) 57<sup>th</sup> Annual Meeting, New Orleans, LA (March)
- 2001 "Airway Remodeling: What It Is and What It Isn't," 25<sup>th</sup> Annual Internal Medicine Conference, Orlando Regional Healthcare, Orlando, FL (March)
- 2001 "Airway Smooth Muscle Biology," Visiting Professor, University of Jordan, Amman, Jordan (April)
- 2001 "Asthma in the New Millennium," Visiting Professor, Northwestern University, Chicago, IL (April)
- 2001 "Airway Smooth Muscle: An Immunomodulatory Cell," Visiting Professor, Cook County Hospital, Chicago, IL (April)
- 2001 "Airway Smooth Muscle Function and Airway Remodeling," Conference on Chronic Lung Diseases, Institut Pasteur Euroconference, Paris, France (June)
- 2001 "Airway Smooth Muscle: Affect or Effect?" Third Triennial World Asthma Meeting, Chicago, IL (July)
- 2001 "Pathophysiology of Asthma: Inflammation and Smooth Muscle Dysfunction," Third Triennial World Asthma Meeting, Chicago, IL (July)
- 2001 "Airway Smooth Muscle Function in Asthma," Visiting Professor, Grand Rounds, University of Chicago (July)
- 2001 "Asthma Therapy in the New Millennium," Visiting Professor, Grand Rounds, Community Medical Center, Scranton, PA (July)
- 2001 "Asthma in the New Millennium," Medical Grand Rounds, Milton S. Hershey Medical Center, Pennsylvania State University (October)
- 2001 "Airway Smooth Muscle Cell Function in Asthma," Pulmonary Grand Rounds, University of Kansas, Kansas City, MO (October)
- 2001 "Airway Smooth Muscle: An Immunomodulatory Cell," Regional Conference, Washington University, St. Louis, MO (October)
- 2001 "Asthma in the New Millennium," Grand Rounds, Washington University, St. Louis, MO (October)
- 2001 "Airway Smooth Muscle: An Immunomodulatory Cell," Plenary Session, National Allergy Meeting, Fukuoka, Japan (October)
- 2001 "Inflammatory Mediators in Asthma," American College of Chest Physicians National Meeting, Philadelphia, PA (November)
- 2001 "Steroid Resistant Asthma," American College of Chest Physicians National Meeting, Philadelphia, PA (November)
- 2001 Visiting Professor, "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Function," University of Nevada, Reno, Department of Pharmacology (November)
- 2001 Visiting Professor, University of Kentucky (November)
- 2001 Visiting Professor, "Airway Smooth Muscle Function," Department of Pharmacology, University of Minnesota (December)
- 2001 Visiting Professor, "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Cell Function," North Carolina State University, Raleigh, NC (January)
- 2002 Visiting Professor, "Airway Remodeling," National Institute of Environmental Health Sciences, Research Triangle Park, NC (January)
- 2002 "Airway Smooth Muscle as an Immunomodulatory Cell: A New Target for Pharmacotherapy?," Symposium, AAAAI 58<sup>th</sup> Annual Meeting, New York, NY (March)
- 2002 "Airway Remodeling: Fact or Fiction?" Tri-State Chest Physicians Conference, Pittsburgh, PA (March)

- 2002 "Airway Smooth Muscle: More Than a Contractile Unit," Pulmonary Grand Rounds, University of Pittsburgh (March)
- 2002 "Asthma in the New Millennium," Grand Rounds, Lehigh Valley Hospital, Allentown, PA (April)
- 2002 "Airway Smooth Muscle Function in Asthma," Visiting Professor, University of Rochester, Strong Memorial Hospital, Rochester, NY (May)
- 2002 "Airway Smooth Muscle: An Immunomodulatory Cell?" Postgraduate Course, ALA/ATS International Conference, Atlanta, GA (May)
- 2002 "Human Airway Smooth Muscle: Regulation of Synthetic Function," Symposium, ALA/ATS International Conference, Atlanta, GA (May)
- 2002 "The Role of Smooth Muscle in Inflammation," Postgraduate Seminar, ALA/ATS International Conference, Atlanta, GA (May)
- 2002 "Molecular and Cellular Mechanisms Leading to Airway Smooth Muscle Remodeling," Postgraduate Seminar, ALA/ATS International Conference, Atlanta, GA (May)
- 2002 "Cell Proliferation in Lymphangioleiomyomatosis," Mini-Symposium, ALA/ATS International Conference, Atlanta, GA (May)
- 2002 "Airway Smooth Muscle Function in Asthma," Symposium, American College of Allergy, Asthma & Immunology, San Antonio, TX (November)
- 2002 "Asthma in the New Millennium," Grand Rounds, Good Samaritan Hospital, Plano, TX (November)
- 2002 "Asthma in the New Millennium," Grand Rounds, Baylor University, Houston, TX (November)
- 2002 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Function," Visiting Pulmonary Scholar, Duke University, Durham, NC (December)
- 2002 "Asthma," Grand Rounds, State University of New York, Stony Brook (December)
- 2003 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle in Health and Disease," Visiting Professor, Pulmonary Research Conference, University of Iowa, Iowa City, IA (January)
- 2003 "Asthma in the New Millennium," Grand Rounds, Welmat Hospital, Bristol, TN (Feb)
- 2003 "Asthma in the New Millennium," Grand Rounds, Graduate Hospital, Philadelphia, PA (March)
- 2003 "Cellular and Molecular Signaling Processes Regulating Smooth Muscle Cell Function," The LAM Foundation/NHLBI Research Conference, Cincinnati, OH (April)
- 2003 "Basic Science Overview," The LAM Foundation/NHLBI Research Conference, Cincinnati, OH (April)
- 2003 "Airway Smooth Muscle Function in Health and Disease," Sixth Annual Dr. and Mrs. Michael A. Gerber Memorial Lecture, Tulane University, New Orleans, LA (April)
- 2003 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Cell Function," Center for Comparative Respiratory Biology and Medicine, University of California at Davis (May)
- 2003 "Asthma: An Acute, Chronic Disease?" Visiting Professor, University of Manitoba, Canada (June)
- 2003 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Cell Function in Health and Disease," Visiting Professor, University of Manitoba, Canada (June)
- 2003 "Asthma in the New Millennium," Grand Rounds and Visiting Professor, University of Cincinnati, Cincinnati, OH (October)
- 2003 "Asthma on the Cutting Edge: Novel Concepts Regarding Immunopathogenesis and Implications for Therapy," Symposium Speaker, American College of Chest Physicians, 69<sup>th</sup> Annual International Scientific Assembly, Orlando, FL (October)
- 2003 "Asthma in the New Millennium," Grand Rounds, Doylestown Hospital, Doylestown, PA (October)
- 2003 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Cell Function," Distinguished Visiting Professor, Center for Cardiovascular Sciences, Albany Medical College, Albany, NY (November)
- 2003 "Asthma in the New Millennium," Pulmonary Medicine Symposium, Butler Memorial Hospital, Butler, PA (November)
- 2003 "Cellular and Molecular Mechanisms Regulating Human Airway Smooth Muscle Cell Function," Visiting Professor, Grand Rounds, McMaster University, Hamilton, Ontario, Canada (November)
- 2004 "Effects of Uncontrolled Asthma," Symposium on Redefining Asthma Control and Treatment, AAAAI 60<sup>th</sup> Annual Meeting, San Francisco, CA (March)
- 2004 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Function in Health and Disease," Pulmonary & Critical Care Grand Rounds, Columbia University, New York, NY (March)
- 2004 "Airway Remodeling: Fact or Fiction?," Pulmonary Grand Rounds, North Shore University Hospital, New Hyde Park, NY (March)
- 2004 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Function," Research Seminar, North Shore University Hospital, New Hyde Park, NY (March)
- 2004 Workshop Director, "Office-Based Procedures: Spirometry," American College of Physicians Annual Session, New Orleans, LA (April)

- 2004 Debate, "Does Smooth Muscle Play a Role in Airway Remodeling in Asthma?" Annual Scientific Meeting, Merck Frosst Medical Advisory Council, Respiratory Section, Toronto, Ontario, Canada (April)
- 2004 "Airway Smooth Muscle: Immunomodulatory Cells," Eastern Allergy Conference, Key Biscayne, FL (May)
- 2004 Invited Speaker, "PDE Function in Airway Smooth Muscle," International Gordon Conference, Pisa, Italy (June)
- 2004 "Asthma and Airway Remodeling: Fact or Fiction?" Grand Rounds, Albert Einstein Healthcare Network, Philadelphia, PA (June)
- 2004 "Airway Smooth Muscle Cell Hyperplasia in Disease," European Respiratory Society Seminar on the Bronchial Smooth Muscle in Airway Responsiveness, Goteborg, Sweden (June)
- 2004 "Airway Smooth Muscle: An Immunomodulatory Cell," Allergy Grand Rounds, University of Texas, Southwest, Dallas, TX (August)
- 2004 "Pathogenesis and Treatment of Irreversible Airflow Obstruction," Colorado Allergy Society (September)
- 2004 "Mechanisms Regulating Irreversible Airflow Obstruction," Allergy Grand Rounds, National Jewish Medical and Research Center, Denver, CO (September)
- 2004 "Asthma in the New Millennium," Central Maine Medical Center, Portland, Maine (October)
- 2004 "Airway Remodeling: Is It Physiologically Relevant?" Pulmonary Grand Rounds, Lahey Clinic, Burlington, MA (October)
- 2004 "Cytokine and Chemokine Regulation of MAPKinase Pathways," Pulmonary Research Group Fall Symposium, Spring House, PA (November)
- 2004 "Phosphodiesterase Inhibition Modulates Airway Smooth Muscle Cell Function in Asthma and Chronic Obstructive Lung Disease," 2<sup>nd</sup> Annual Phosphodiesterases in Drug Discovery & Development Conference, Philadelphia, PA (November)
- 2004 "Cellular and Molecular Mechanisms Regulating Smooth Muscle Function," Pulmonary Grand Rounds, Wake Forest University, Winston-Salem, NC (November)
- 2004 "Airway Smooth Muscle: More Than Just Contraction in Asthma and COPD," Visiting Pulmonary Scholar Lecture, Duke University Medical Center, Durham, NC (December)
- 2005 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Function in Health and Disease," Pulmonary Grand Rounds, New England Medical Center, Boston, MA (January)
- 2005 "Smooth Muscle: A New Therapeutic Target?" International Asthma Meeting, Brussels, Belgium (February)
- 2005 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Function," Pulmonary Research Conference, Brown University, Providence RI (February)
- 2005 "Asthma: A Disease of Irreversible Airway Obstruction," Medical Grand Rounds, Rhode Island Hospital, Providence, RI (March)
- 2005 "Airway Remodeling," The John E. Salvaggio Memorial Lectureship, AAAAI 61<sup>st</sup> Annual Meeting, San Antonio, TX (March)
- 2005 "Airway Remodeling in Asthma," State-of-the-Art Seminar Session, AAAAI 61<sup>st</sup> Annual Meeting, San Antonio, TX (March)
- 2005 "Pathological Control," Interest Section Forum, AAAAI 61<sup>st</sup> Annual Meeting, San Antonio, TX (March)
- 2005 "The Role of Airway Smooth Muscle in Airway Inflammation and Remodeling," Workshop Q&A, AAAAI 61<sup>st</sup> Annual Meeting, San Antonio, TX (March)
- 2005 Co-Director, Clinical Skills Workshop on Office-Based Procedures: Spirometry, American College of Physicians Annual Session, San Francisco, CA (April)
- 2005 "Beyond a Structural Role: Contribution of Smooth Muscle to Airway Remodeling," Symposium Speaker: "Extracellular Matrix Regulators During Pathophysiological Lung Remodeling: Implications for Therapy," American Thoracic Society International Conference, San Diego, CA (May)
- 2005 "The Therapeutic Targets in Cell Signaling: Where to Start and End?" Symposium Speaker: "Intracellular Signaling Molecules: New Therapeutic Targets in Treatment of Asthma and COPD," American Thoracic Society International Conference, San Diego, CA (May)
- 2005 "Airway Smooth Muscle – More Than Just a Contraction," University of Vermont Lung Center, Burlington, VT (July)
- 2005 "Airway Remodeling in Asthma," Johns Hopkins University, Baltimore, MD (July)
- 2005 "Airway Remodeling: What's New," Pulmonary Grand Rounds, University of Washington, Harborview Hospital, Seattle, WA (September)
- 2005 "The Cellular and Molecular Mechanisms That Regulate Airway Smooth Muscle Function," Allergy/Immunology Grand Rounds, University of Washington, Harborview Hospital, Seattle, WA (September)

- 2005 "Airway Remodeling: Fact or Fiction?" Pulmonary Grand Rounds, Boston University, Boston, MA (November)
- 2006 "Asthma Update," Pri-Med Institute, Cleveland, OH (March)
- 2006 "Asthma, Airway Remodeling and Smooth Muscle," Department of Medicine Grand Rounds, Maine Medical Center, Portland, ME (April)
- 2006 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Function," Housestaff Lecture, Maine Medical Center, Portland, ME (April)
- 2006 "Airway Remodeling: Fact or Fiction?" Dokkyo Medical University, Japan (July)
- 2006 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Function in Asthma and COPD," 8<sup>th</sup> Annual Asthma Remodeling Research Meeting, Tokyo, Japan (July)
- 2006 "Airway Remodeling: Fact or Fiction?" Pulmonary Grand Rounds, University of Alabama, Birmingham (July)
- 2006 "Airway Smooth Muscle Cellular and Molecular Signaling Pathways That Modulate Function," Birmingham, Alabama (July)
- 2006 "Give Me the Patient's Smooth Muscle Cells and I Will Tell You How to Develop Effective Anti-Asthma Therapy – Pro," Symposium on Pro/Con: Asthma Is (Not) an Inflammatory Disease, European Respiratory Society Annual Congress, Munich, Germany (September)
- 2006 "Overview of the Salmeterol Multicenter Asthma Research Trial (SMART) and the Management of Inflammation and Bronchoconstriction in Adults with Asthma," Pulmonary Grand Rounds, Johns Hopkins University, Baltimore, MD (September)
- 2006 "Molecular Mechanisms Regulating Airway Smooth Muscle Function," Molecular Medicine Seminar, University of Chicago, Chicago, IL (September)
- 2006 "State of the Science: Emerging Issues in Basic Asthma," Nebraska Academy of Allergy Dinner, Omaha, NE (October)
- 2006 "Airway Remodeling: Fact or Fiction?" Grand Rounds, Creighton University, Omaha, NE (October)
- 2006 "Airway Smooth Muscle: An Immunomodulatory Cell?" Invited Speaker, Third International Symposium on Respiratory Diseases, Shanghai, China (November)
- 2006 "Airway Remodeling: Fact or Fiction?" Pulmonary Grand Rounds, Vanderbilt University, Nashville, TN (December)
- 2007 Clinical Roundtable on Airway Remodeling in Asthma, Robert Wood Johnson University Hospital, New Brunswick, NJ (January)
- 2007 "New Approaches to the Management of COPD," St. Joseph's Regional Medical Center, Clifton, NJ (January)
- 2007 "Cellular and Molecular Mechanisms Regulating Airway Smooth Muscle Function," Departments of Physiology and Medicine Research Symposium, University of Vermont College of Medicine, Burlington, VT (March)
- 2007 "Asthma and Airway Remodeling," Medical Grand Rounds, University of Medicine and Dentistry of New Jersey Hospital, Newark, NJ (March)
- 2007 "New Approaches to the Management of COPD," Medical Grand Rounds, Chester County Hospital, West Chester, PA (March)
- 2007 "New Approaches to the Management of COPD," Medical Grand Rounds, MetroWest Medical Center, Framingham, MA (April)
- 2007 "An Update on COPD," Grand Rounds, St. Joseph's Hospital, Paterson, NJ (April)
- 2007 "Understanding Airway Remodeling and Asthma Disease Progression," Peer Discussion Group, San Francisco, CA (May)
- 2007 "Assessment and Management of COPD and Asthma in the Perioperative Period," American Thoracic Society International Conference, San Francisco, CA (May)
- 2007 "Immunomodulatory Role of Mesenchymally Derived Cells in Asthma," American Thoracic Society International Conference, San Francisco, CA (May)
- 2007 "Understanding Airway Remodeling and Asthma Disease Progression," Pediatric Pulmonary Grand Rounds, Johns Hopkins University, Baltimore, MD (June)
- 2007 "Understanding Airway Remodeling and Asthma Disease Progression," Medical Grand Rounds, Howard University, Washington, DC (June)
- 2007 "Molecular Regulation of the Smooth Muscle," Symposium Speaker, XXVI Congress of the European Academy of Allergology and Clinical Immunology (EAACI), Göteborg, Sweden (June)
- 2007 "Asthma," Grand Rounds, Providence St. Vincent's Hospital, Portland, OR (September)
- 2007 "Airway Remodeling: Fact or Fiction?" Pulmonary Grand Rounds, Oregon Health Sciences University, Portland, OR (September)

- 2007 Panel Expert, Center Directors Meeting, National Institute of Environmental Health Sciences, Corvallis, OR (October)
- 2007 "Asthma in the New Millennium," Grand Rounds, Georgetown University Hospital, Washington, DC (October)
- 2007 "LTRA's Role in Asthma-Related Cough," Local Symposium Speaker, Shanghai, China (November)
- 2007 "Airway Remodeling: What Is Physiologically Relevant?" Invited Speaker, Fourth International Symposium on Respiratory Diseases, Shanghai, China (November)
- 2007 "Airway Smooth Muscle As An Immunomodulatory Cell," Keynote Speaker, Sixth International Young Investigators' Symposium on Smooth Muscle, Sydney, Australia (November)
- 2007 "Antileukotrienes: Can They Affect Remodeling?" Symposium Speaker, American College of Allergy, Asthma & Immunology Annual Meeting, Dallas, TX (November)
- 2008 "Airway Remodeling and Irreversible Airway Obstruction: Fact or Fiction?" Medical Grand Rounds, Oklahoma University Health Sciences Center, Oklahoma City, OK (January)
- 2008 "Assessing Asthma Control: New Tools and Strategies," Philippine Medical Society, Toms River, NJ (January)
- 2008 "Airway Remodeling and Asthma Disease Progression: Implications for Treatment," Pediatric Grand Rounds, Wilmington Hospital, Wilmington, DE (March)
- 2008 "Role of Transcription Factors NF- $\kappa$ B and AP-1 in TNF $\alpha$ -Induced Airway Hyperreactivity," Workshop Q&A Speaker, AAAAI Annual Meeting, Philadelphia, PA (March)
- 2008 "The Human Airways: Structure-Function Relationships in Asthma," Discussion Leader, AAAAI Annual Meeting, Philadelphia, PA (March)
- 2008 "Role of Smooth Muscle in Severe Asthma," Workshop Speaker, AAAAI Annual Meeting, Philadelphia, PA (March)
- 2008 "Airway Remodeling: Fact or Fiction?" Pulmonary & Critical Care Grand Rounds, Cleveland Clinic, Cleveland, OH (March)
- 2008 "Ozone, Asthma and Beyond," Environmental Health Sciences Seminar, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD (April)
- 2008 "Difficult Asthma – the Latest Updates," Allergic Disease Forum, Tokyo, Japan (April)
- 2008 "Increase Inhaled Corticosteroids," Symposium on Managing Rhinitis: Strategies to Fill the Unmet Need, Eastern Allergy Conference, Naples, FL (May)
- 2008 "Severe Asthma Phenotypes," Symposium on Evolving Understanding and Treatment of Severe Allergic Asthma, Eastern Allergy Conference, Naples, FL (May)
- 2008 "Asthma," Pulmonary Grand Rounds, Cooper University Hospital, Camden, NJ (May)
- 2008 "Airway Smooth Muscle Function in Asthma," Research Seminar, National Institute of Allergy and Infectious Diseases, Bethesda, MD (July)
- 2008 "Understanding Airway Remodeling and Asthma Disease Progression," VA Medical Center, San Francisco, CA (September)
- 2008 "Cysteinyl Leukotrienes: Important Mediators in the Pathogenesis of Allergic Rhinitis," Beth Israel Hospital, Newark, NJ (September)
- 2008 "Airway Remodeling: Fact or Fiction?" Primary Care Grand Rounds, Bayfront Medical Center, St. Petersburg, FL (November)
- 2008 "Airway Smooth Muscle: More Than a Contraction?" Visiting Professor, Department of Physiology, University of Massachusetts Medical School, Worcester, MA (December)
- 2009 "Airway Smooth Muscle: More Than Shortening," Invited Speaker, iCAPTURE Center for Cardiovascular and Pulmonary Research, University of British Columbia, Vancouver, BC (February)
- 2009 "Airway Smooth Muscle: More Than Contraction?" Pulmonary Grand Rounds, University of Miami Miller School of Medicine, Miami, FL (March)
- 2009 "Is Airway Smooth Muscle the 'Missing Link' Modulating Airway Inflammation in Asthma?" Symposium Speaker, AAAAI Annual Meeting, Washington, DC (March)
- 2009 "How Corticosteroids Prevent Beta Receptor Tolerance in Small Airways," Symposium Speaker, AAAAI Annual Meeting, Washington, DC (March)
- 2009 "Airway Smooth Muscle: New Insight Into Irreversible Airway Obstruction," Visiting Professor Seminar, University of North Carolina, Chapel Hill, NC (August)
- 2009 "Airway Smooth Muscle Function in Asthma: New Insights in Irreversible Airway Obstruction," Visiting Professor, Harvard University, Brigham & Women's Hospital, Boston, MA (September)
- 2009 "State of the Science: Emerging Issues in Basic Asthma Research," Grand Rounds, Buffalo General Hospital, Buffalo, NY (September)
- 2009 "Airway Remodeling and Asthma Disease Progression: Implications for Treatment," Buffalo Allergy Society, Williamsville, NY (September)

- 2009 "Advances in COPD: Diagnosis, Management, and Patient Communication," Grand Rounds, Monmouth Medical Center, Long Branch, NJ (October)
- 2009 "Practical Approaches to Translating Asthma Guidelines into Everyday Clinical Practice," PriMed Access Meeting, Philadelphia, PA (October)
- 2009 "Assessing and Managing Asthma Control," JFK Medical Center, Philadelphia, PA (October)
- 2009 "Understanding the Scope and Burden of COPD," Potomac Center for Medical Education Symposium on Improving COPD Patient Outcomes, Philadelphia, PA (October)
- 2009 "Updates in COPD Management: From Guidelines to Clinical Practice," Potomac Center for Medical Education Symposium on Improving COPD Patient Outcomes, New York, NY (October)
- 2009 "Airway Smooth Muscle in Asthma: New Targets," Carter Immunology Center, University of Virginia, Charlottesville, VA (November)
- 2010 "Asthma: Challenges in Treating a Heterogeneous Disease," Coventry Family Care, Pottstown, PA (January)
- 2010 "Understanding Airway Remodeling and Asthma Disease Progression," San Diego Allergy Society, San Diego, CA (February)
- 2010 "Understanding Airway Remodeling and Asthma Disease Progression," Phoenix Allergy Society, Scottsdale, AZ (February)
- 2010 "Can We Alter the Course of Remodeling and How Can We Do It?" AAAAI Dinner Symposium, New Orleans, LA (February)
- 2010 "Asthma: Challenges in Treating a Heterogeneous Disease," Hilton City Line Avenue, Philadelphia College of Osteopathic Medicine, Internal Medicine Grand Rounds, Philadelphia, PA (March)
- 2010 "Understanding Asthma vs. COPD: A Focus on COPD Treatment," St. Mary Medical Center, Langhorne, PA (March)
- 2010 "State of the Science: Emerging Issues in Basic Asthma Research," UMDNJ, Allergy & Immunology Grand Rounds, Newark, NJ (April)
- 2010 "Differential Diagnosis and the Treatment of COPD," Owosso Medical Group, Owosso, MI (May)
- 2010 "Steroid Insensitive Airways Disease: New Frontiers," University Hospitals Case Medical Center, Cleveland, OH (June)
- 2010 "Asthma: Challenges in Treating a Heterogeneous Disease," Pennsylvania Convention Center, Philadelphia, PA (June)
- 2010 "Smooth Muscle as an Inflammatory Organ," 9<sup>th</sup> International Congress on Pediatric Pulmonology, Vienna, Austria (June)
- 2010 "Asthma and Reversible Airway Obstruction: New Insights," Pulmonary Grand Rounds, University of Louisville HealthCare Outpatient Center, Louisville, KY (July)
- 2010 "Update on Airway Remodeling," Update in Allergy and Immunology Symposium, Nassau University Medical Center, East Meadow, NY (October)
- 2010 "Airway Smooth Muscle Function in Steroid-Insensitive Asthma," Fifth Annual Nemacolin Asthma Conference, Farmington, PA (October)
- 2010 "Molecular Immunology of Asthma," Allergy Grand Rounds, Creighton University, Omaha, NE (December)
- 2011 "Airway Smooth Muscle and Steroid Insensitivity: New Insights," Visiting Professor, Department of Physiology and Biophysics, University of Arkansas for Medical Sciences, Little Rock, AR (January)
- 2011 "Asthma: Challenges in Treating a Heterogeneous Disease," Grand Rounds, Oklahoma State University Hospital, Tulsa, OK (January)
- 2011 "New Insights in Irreversible Airway Obstruction in Severe Asthma," Asthma Center Seminar, Cleveland Clinic, Cleveland, OH (February)
- 2011 "Environmental Health Concerns of Nanoparticles and Human Precision Cut Lung Slices: A Novel Model for Drug Discovery and Target Validation," Wyss Institute at Harvard University, Boston, MA (February)
- 2011 "Irreversible Airway Obstruction in Asthma: New Approaches," Allegheny General Hospital CME: Update on Allergy, Asthma and Immunology, Pittsburgh, PA (June)
- 2011 "Natural Progression of Asthma," Invited Speaker, Pennsylvania Allergy & Asthma Association Annual Meeting, Hershey, PA (June)
- 2011 "Irreversible Airway Disease," Invited Speaker, Pennsylvania Allergy & Asthma Association Annual Meeting, Hershey, PA (June)
- 2011 "Airway Remodeling and Physiological Relevance," Invited Speaker, California Society of Allergy, Asthma and Immunology Annual Educational Meeting, Huntington Beach, CA (July)
- 2011 "Glucocorticoid-Insensitive Asthma: Diagnosis and Treatment: Can Vitamin D Play a Role in Treatment?" Invited Speaker, California Society of Allergy, Asthma and Immunology Annual Educational Meeting, Huntington Beach, CA (July)

- 2011 "Steroid Insensitivity in Asthma," Invited Speaker, Long Island Allergy and Asthma Society 18<sup>th</sup> Annual Scientific Conference, Montauk, Long Island, NY (September)
- 2011 "Challenges in COPD Management: What are the Novel Therapeutics?" Invited Speaker, Long Island Allergy and Asthma Society 18<sup>th</sup> Annual Scientific Conference, Montauk, Long Island, NY (September)
- 2011 "Novel Therapies Targeting Airway Smooth Muscle in Asthma," Medicine Grand Rounds, Cleveland Clinic, Cleveland, OH (September)
- 2011 "New Asthma Therapeutics: Target Airway Smooth Muscle," Pulmonary Research Lecture Series, Children's Hospital of Philadelphia, PA (October)
- 2011 "Remodeling in Pediatric and Adult Asthma: What Does It Mean to the Patient and Physician?" Invited Faculty Member, Future Directions in Respiratory Disease Symposium, Ponte Vedra Beach, FL (October)
- 2011 "Glucocorticoid-Insensitive Asthma: Diagnosis and Treatment: Can Vitamin D Play a Role in Treatment?" Invited Speaker, New Jersey Allergy, Asthma and Immunology Society Teaching Day, Clark, NJ (October)
- 2011 "Glucocorticoid-Insensitive Asthma: Diagnosis and Treatment: Can Vitamin D Play a Role in Treatment?" Medical Grand Rounds, Allegheny General Hospital, Pittsburgh, PA (October)
- 2011 "Allergen Environmental Control Benefits Asthma," Pro-Con Debate Speaker and Invited Discussant, Sixth Annual Nemacolin Asthma Conference, Farmington, PA (October)
- 2011 "Airway Smooth Muscle: A New Target in the Treatment of Irreversible Airflow Obstruction in Asthma?" Visiting Professor, Center for Lung Biology Research Seminar Series, University of Southern California Keck School of Medicine, Los Angeles, CA (November)
- 2011 "Steroid Insensitivity: How Does Airway Smooth Muscle Contribute," Invited Speaker, 21<sup>st</sup> Annual Johns Hopkins Asthma and Allergy Center Symposium: Airway Remodeling: From Nose to Lung, Baltimore, MD (November)
- 2011 "The Clinical Profile of Roflumilast," Pulmonary Grand Rounds, Deborah Heart and Lung Center, Browns Mills, NJ (December)
- 2012 "Clinical Considerations in the Assessment and Management of Asthma," Pulmonary Grand Rounds, Hospital Municipal de San Juan, Rio Piedras, Puerto Rico (February)
- 2012 "Vitamin D: An Anti-Inflammatory Therapy in Asthma," Asthma and Airway Diseases Conference, Washington University School of Medicine, St. Louis, MO (March)
- 2012 "Airway Remodeling in Asthma: Irreversible Airway Obstruction?" Pulmonary Grand Rounds, Washington University School of Medicine, St. Louis, MO (March)
- 2012 "Glucocorticoid-Insensitive Asthma-Diagnosis and Treatment: Can Vitamin D Play a Role in Treatment?" Allergy-Immunology Teach Series, University of Washington, Seattle, WA (April)
- 2012 "Improving Asthma Outcomes: Factors to Consider," Pediatric Grand Rounds, Wilmington Hospital, Wilmington, DE (April)
- 2012 "Irreversible Airflow Obstruction in Severe Asthma: What Can We Do?" Medical Grand Rounds, Harbor-UCLA Medical Center, Torrance, CA (May)
- 2012 "Airway Remodeling and Irreversible Obstruction: Master Switches?" Pulmonary Special Lecture Series, David Geffen School of Medicine at UCLA, Los Angeles, CA (May)
- 2012 "Irreversible Asthma: What Is the Phenotype?" Pediatric Grand Rounds, West Virginia University Health Sciences Center, Morgantown, WV (June)
- 2012 "Steroid Insensitivity in Asthma: The Role of Airway Smooth Muscle," Pediatric Research Forum, West Virginia University Health Sciences Center, Morgantown, WV (June)
- 2012 "The Evolving Science of Asthma," Allergy and Rheumatology Grand Rounds, University of Kansas Medical Center, Kansas City, KS (June)
- 2012 "State of the Science: Emerging Issues in Basic Asthma Research," Medical Forum/Peer Discussion Group, University of California, Davis, Sacramento, CA (July)
- 2012 "Vitamin D: An Anti-Inflammatory Therapy in Asthma," Center for Comparative Respiratory Biology Medicine, University of California, Davis, Sacramento, CA (July)
- 2012 "The Evolving Science of Asthma," Pulmonary Grand Rounds, Lahey Clinic, Burlington, MA (August)
- 2012 "Is It Severe Asthma or COPD? Is Either Disease Steroid Responsive?" Guest Speaker, Innovations in Allergy, Asthma & Immunology Management Conference, Penn State Hershey College of Medicine, Hershey, PA (September)
- 2012 "The Asthmatics: Airway Biology and the Management of Difficult Asthma," Guest Faculty for Conference on Pulmonary Medicine: Emphasis on Airway Diseases, Geisinger Health System, Danville, PA (September)
- 2012 "Novel Therapeutic Approaches to Treat Airways Diseases: Focus on Severe Asthma and COPD," Guest Speaker, Faculty of Medicine and Surgery, Catania, Italy (October)
- 2012 "Severe Asthma: What to Do?" Medical Grand Rounds, Nazareth Hospital, Philadelphia, PA (October)

- 2012 "Airway Smooth Muscle: A New Target in the Treatment of Irreversible Airflow Obstruction in Asthma?" Pulmonary Research Conference, University of Nebraska Medical Center, Omaha, NE (October)
- 2012 "Novel Therapies Targeting Airway Smooth Muscle in Asthma," Medicine Grand Rounds, University of Nebraska Medical Center, Omaha, NE (October)
- 2012 "*In Vitro* and *Ex Vivo* Models for Steroid-Resistant Asthma," Charles River Fall 2012 Pulmonary Research Group Symposium, "Defining and Modeling Complex Asthma Phenotypes," Radnor, PA (November)
- 2013 "The Evolving Science of Asthma," Medical Grand Rounds, Beth Israel Hospital, Newark, NJ (January)
- 2013 "Irreversible Airway Obstruction in Asthma: Is It Really Remodeling?" Western Society of Allergy, Asthma and Immunology 51<sup>st</sup> Annual Scientific Session, Kohala Coast, Hawaii (January)
- 2013 "Steroid-Insensitive Asthma," Western Society of Allergy, Asthma and Immunology 51<sup>st</sup> Annual Scientific Session, Kohala Coast, Hawaii (January)
- 2013 "Ozone and Airway Hyperresponsiveness: New Insights?" Visiting Professor, Environmental and Occupational Health Sciences Institute (EOHSI)/NIEHS, UMDNJ-Robert Wood Johnson Medical School and Rutgers University, Piscataway, NJ (March)
- 2013 "Airway Smooth Muscle: Cell Signaling to New Therapeutics in Asthma and COPD," Visiting Professor, Department of Pharmacology & Chemical Biology, University of Pittsburgh School of Medicine, Pittsburgh, PA (April)
- 2013 "Irreversible Airway Obstruction in Asthma: Can It Be Prevented?" Invited Speaker, Eastern Allergy Conference, Palm Beach, FL (June)
- 2013 "Severe Asthma: What to Do?" Grand Rounds, Roxborough Memorial Hospital, Philadelphia, PA (June)
- 2013 "Airway Smooth Muscle: New Therapeutic Targets," Visiting Scientist, Amgen Inc., Thousand Oaks, CA (June)
- 2013 "Airway Smooth Muscle: Cell Signaling to New Therapeutics in Asthma and COPD," Visiting Professor, Department of Pharmacology, Creighton University School of Medicine, Omaha, NE (June)
- 2013 "Severe Asthma: What to Do?" Guest Speaker, Nebraska Academy of Allergy Meeting, Omaha, NE (June)
- 2013 "The Difficult Asthma Patient: What's Next When All Else Fails?" Invited Speaker, California Society of Allergy, Asthma and Immunology Annual Educational Meeting, Huntington Beach, CA (June)
- 2013 "Optimal Utilization of Bronchial Thermoplasty in the Complex Asthma Patient, Invited Speaker, California Society of Allergy, Asthma and Immunology Annual Educational Meeting, Huntington Beach, CA (June)
- 2013 "Severe Asthma: What to Do?" Grand Rounds, Barnabas Health Community Medical Center, Toms River, NJ (August)
- 2013 "Bronchial Thermoplasty – A Revolutionary Treatment in Asthma," Association of Asthma Educators Annual Conference, Charleston, SC (August)
- 2013 "Managing Workers with Asthma: New Insights into an Acute and Chronic Disease," Pennsylvania Occupational and Environmental Medical Society, Fall Occupational Medicine Conference, Philadelphia, PA (September)
- 2013 "Airway Smooth Muscle in Asthma: Just a Target for Bronchodilation?" Invited Speaker, Eighth Annual Nemacolin Asthma Conference, Farmington, PA (November)
- 2013 "Previewing Future Health Research," Pennsylvania League of Women Voters Conference on Shale Drilling and Public Health: A Day of Discovery, Pittsburgh, PA (November)
- 2013 "Bronchial Thermoplasty in Severe Asthma: A New Treatment Option?" Invited Speaker, Teva Respiratory Forum, Barcelona, Spain (December)
- 2013 "Severe Asthma: What to Do?" Grand Rounds, Mercy Fitzgerald Hospital, Darby, PA (December)
- 2014 "Airway Smooth Muscle: A Target for Severe Asthma," Invited Speaker, Genentech, South San Francisco, CA (February)
- 2014 "Groundwater Quality and Health Outcomes in Adjacent Areas With and Without Hydro-Fracturing Activities," and "Where Do We Go from Here?" Speaker, Symposium on Impact of Unconventional Natural Gas Drilling Operations on the Environment and Public Health, Center of Excellence in Environmental Toxicology and Center for Public Health Initiatives, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA (February)
- 2014 "The Role of Anti-Cholinergics, Vitamin D Replacement and Fine Particle ICS," Speaker, Symposium on Treatment Alternatives for Refractory Severe Asthma, AAAAI Annual Meeting, San Diego, CA (March)
- 2014 "Severe Asthma: What to Do?" Medicine Grand Rounds, Cooper University Hospital, Camden, NJ (March)
- 2014 "Glucocorticoid Insensitivity in Airways Disease," Panel Speaker, COPD Istanbul 2014, Istanbul, Turkey (March)
- 2014 "Airway Smooth Muscle: Novel Therapeutic Targets in COPD," Plenary Session Speaker, COPD Istanbul 2014, Istanbul, Turkey (March)

- 2014 "Different Technologies for Collection and Analysis of Data on Biomarkers," Panel Speaker, COPD Istanbul 2014, Istanbul, Turkey (March)
- 2014 "Management of Severe Asthma," CME Program: Advances in Pulmonary Care: An Update, Philadelphia County Medical Society, Philadelphia, PA (March)
- 2014 "Airway Smooth Muscle: Novel Therapeutic Approaches in Severe Asthma," Asthma Grand Rounds, Montefiore Medical Center, Bronx, NY (March)
- 2014 "Bronchial Thermoplasty in Severe Asthma: A New Treatment Option?" Invited Speaker, Teva Respiratory Forum, Lisbon, Portugal (June)
- 2014 "Bronchial Thermoplasty: A (R)evolutionary Treatment in Asthma," Aspen Allergy Conference, Aspen, CO (July)
- 2014 "The Physician Scientist: Evolution, Revolution and Revelation," Tenth Annual Respiratory Disease Young Investigators Forum, Washington, DC (October)
- 2014 "Unconventional Gas and Oil Drilling: Insights into Health Consequences," Pennsylvania League of Women Voters Conference on Shale Drilling and Public Health: Days of Discovery, Pittsburgh, PA (October)
- 2014 "Severe Asthma: What to Do?" Grand Rounds, Delaware County Memorial Hospital, Drexel Hill, PA (December)
- 2015 Symposium Speaker, "Th2 Cytokine Antagonists in COPD," Presidential Symposium on Th2 Immune Response Modifiers for Severe Airway Disease, AAAAI Annual Meeting, Houston, TX (February)
- 2015 Invited Speaker, "Summary of Newer Approved Therapies (LAMA and Once Daily LABA) for COPD and Potential Use in Asthma," Session on ADT: Frontiers in Obstructive Airway Therapies, AAAAI Annual Meeting, Houston, TX (February)
- 2015 Invited Speaker, "Asthma-COPD Overlap Syndrome," Airway Vista Chronic Obstructive Pulmonary Disease Symposium, Asan Medical Center, Seoul, South Korea (March)
- 2015 Invited Speaker, "Airway Smooth Muscle: A Target for Novel Therapies in Asthma and COPD," Airway Vista Chronic Obstructive Pulmonary Disease Symposium, Asan Medical Center, Seoul, South Korea (March)
- 2015 Moderator, Poster Discussion Session on Asthma, Airway Vista Chronic Obstructive Pulmonary Disease Symposium, Asan Medical Center, Seoul, South Korea (March)
- 2015 Visiting Professor, "Novel Models in Translation: Asthma and Airway Smooth Muscle," Rutgers New Jersey Medical School, Newark, NJ (April)
- 2015 "Airway Smooth Muscle: A Novel Therapeutic Target in Severe Asthma," Recognition Award for Scientific Accomplishments, American Thoracic Society International Conference, Denver, CO (May)
- 2015 Invited Speaker, "Biomarkers Predicting Therapeutic Response in Asthma and COPD," Eastern Allergy Conference, Palm Beach, FL (May)
- 2015 Invited Speaker, "Improving COPD Outcomes," Eastern Allergy Conference, Palm Beach, FL (May)
- 2015 Oral Presentation, What Is the Role of Lung Inflammation in Mediating Particulate Matter and Ozone Exposure Effects on Health and Disease? Session on Health Impacts of Atmospheric Particles, Goldschmidt Conference, Prague, CZ (August)
- 2015 "The Future of Targeted Therapy: Asthma and COPD," and "Airway Smooth Muscle: Novel Targets for Managing Asthma and COPD," Invited Speaker, Eastern Pulmonary Conference, Palm Beach, FL (September)
- 2015 "Budesonide Augments Formoterol-Induced Bronchodilation of Human Small Airways Within Minutes," Thematic Poster Presentation, European Respiratory Society International Congress, Amsterdam, The Netherlands (September)
- 2015 "The Physician Scientist: Evolution, Revolution and Revelation," 11<sup>th</sup> Annual Respiratory Disease Young Investigators Forum, Atlanta, GA (October)
- 2015 "Bronchial Thermoplasty – The Science and Identification of Responders," Mini-Symposium on Asthma and COPD – COPD Overlap Syndrome (ACOS), Invited Speaker, Tenth Annual Nemacolin Asthma Conference, Farmington, PA (October-November)
- 2015 "Chronic Airway Obstruction: What Does That Mean? Defining and Categorizing ACOS," Symposium on Asthma, COPD and Asthma-COPD Overlap Syndrome, American College of Allergy, Asthma & Immunology Annual Scientific Meeting, San Antonio, TX (November)
- 2015 "Diagnostic Workup for Difficult to Control Asthma," Workshop Presenter, American College of Allergy, Asthma & Immunology Annual Scientific Meeting, San Antonio, TX (November)
- 2015 "Airway Smooth Muscle: A Target for Novel Therapies in Asthma and COPD," Cold Spring Harbor Asia Conference on Development and Pathophysiology of the Respiratory System, Suzhou, China (November)
- 2016 "Asthma Update: Precision Approaches", 2016 Advances in Pulmonary and Critical Care Medicine Conference, Inova Fairfax Medical Campus, Falls Church, VA. (March)

- 2016 "Evidence of Asthma Severity: Identifying At-Risk Patients", Chair, Teva Respiratory program, Los Angeles, CA (March)
- 2016 "How Bronchial Smooth Muscle Cells Make Airways Hyperresponsive", Moderator, Workshop 2807, American Academy of Allergy, Asthma and Immunology Annual Meeting, Los Angeles, CA. (March)
- 2016 "Asthma Update: Precision Approaches", Invited Speaker, New Jersey Thoracic Society Annual Scientific Session, New Brunswick, NJ (April)
- 2016 "The Future of Targeted Therapy: Asthma and COPD" and "Airway Smooth AMuscle: Novel Targets for Managing Asthma and COPD", Invited Speaker, Kentucky Allergy Society Spring Meeting, Lexington, KY (April).
- 2016 "Airway Smooth Muscle: A Therapeutic Target in Severe Persistent Asthma", Medical Grand Rounds, Princeton Healthcare System, Princeton, NJ (April).
- 2016 "Unconventional Gas and Oil Drilling is Associated with Increased Hospital Utilization Rates", National Center for Environmental Assessment (webinar), New Brunswick, NJ (April).
- 2016 "Bronchial Thermoplast: The Science and Identification of Responders", Invited Speaker, Boston Scientific Practical Workshop, San Francisco, CA (May).
- 2016 "Understanding Disease Heterogeneity and the Importance of Biomarkers", AZ Symposium Speaker: Unmet Need in Uncontrolled Asthma, San Francisco, CA (May).
- 2016 "Mechanism of Disease in Severe Asthma: A Focus on Eosinophils", AZ Symposium Speaker: Florida Allergy, Immunology and Asthma Society annual meeting, Orlando, FL (July).
- 2016 "Airway Structural Alterations that Contribute to Severe Asthma", American Academy of Allergy, Asthma and Immunology Life Spectrum of Asthma, Chicago, IL (July).
- 2016 "Airway Structural Alterations that Contribute to Severe Asthma", Workshop Moderator: AAAAI Life Spectrum of Asthma, Chicago, IL (July).
- 2016 Case Discussion Moderator, Symposium on Preventing and Treating Severe Asthma, American Academy of Allergy, Asthma and Immunology Life Spectrum of Asthma, Chicago, IL (July).
- 2016 "Personalized and targeted therapies – which target to choose?", Symposium speaker: International ERS Congress, London, England (September).
- 2016 "Novel Treatments for Asthma and COPD", Invited Speaker: Eastern Pulmonary Conference, Orlando, FL (September).
- 2016 "RGS Protein Dysfunction in Asthma", Invited Speaker: Australian Society of Clinical and Experimental Pharmacologists and Toxicologists (ASCEPT), Melbourne, Australia (November)
- 2016 "Precision Cut Lung Slices: Models for the Study of Airway Disease Exacerbations", Invited Speaker: The Woolcock Institute, Sydney, Australia (November)
- 2016 "Airway Smooth Muscle: A Target for Difficult to Manage Airways Disease", Invited Speaker: Department of Pharmacology and Therapeutics, University of Melbourne (November)
- 2017 "Optimizing Medical Management of Severe Asthma", Invited Speaker: North American Rhinology and Allergy Conference (February)
- 2017 "Asthma: Precision Approaches", Invited Speaker: 2017 International Lung Imaging Workshop (March)
- 2017 "The Paucigranulocytic Phenotype: Is Airway Remodeling Relevant?", Invited Speaker: 2017 AAAAI Annual meeting (March)
- 2017 "Deciphering the Maze of Biological Therapy in Asthma", Invited Speaker: 2017 AAAAI Annual Meeting (March)
- 2017 "IgE or Not IgE, That is the Question – Anti-eosinophil", Invited Speaker: 2017 AAAAI Annual Meeting (March)
- 2017 "Severe Asthma", Invited Speaker: Winthrop University Hospital Grand Rounds (April)
- 2017 "Precision Medicine: A Promissory Note", Invited Speaker: OHRP Research Community Forum (March)
- 2017 "Redefining Severe Uncontrolled Asthma", Invited Speaker: University of Maryland School of Medicine Grand Rounds (April)
- 2017 "Mechanisms of Airway Hyperresponsiveness and Remodeling", Session Co-Chair: American Thoracic Society 2017 International Conference (May)
- 2017 "Airway Smooth Muscle and Airway Inflammation: a Dangerous Liaison?", Invited Speaker: Corso Di Alta Formazione in Malattie Dell'Apparato Respiratorio (Catania, Italy, June)
- 2017 "Precision Medicine in Severe Asthma", Invited Speaker: Florida Allergy, Asthma and Immunology Society (June)
- 2017 "Neutrophilic and pauci-immune phenotypes of asthma", Invited Speaker: Eastern Pulmonary Conference (August)
- 2017 "Case Study: The approach to severe persistent asthma", Session leader: Eastern Pulmonary Conference (August)
- 2017 "The comorbidities of COPD", Breakout Session: Eastern Pulmonary Conference (August)

- 2017 "The Physician Scientist: Evolution, Revolution and Revelation", Invited speaker: Thirteenth Annual Respiratory Disease Young Investigators' Forum (October)
- 2017 "The physiological rationale for using bronchodilators", Invited Speaker: International Symposium on Pharmacology and Therapeutics of Bronchodilators, University of Rome (October)
- 2017 "Precision Cut Lung Slices (PCLS): A Human Model for discovery of Novel Therapeutics", Invited Speaker: University of Texas Health Science Center McGovern Medical School, Houston, TX (November)
- 2017 "Asthma Update: Precision Approaches", Invited Speaker: Mount Sinai-National Jewish Health Respiratory Institute, Icahn School of Medicine, New York, NY (November)
- 2017 "Asthma Update: Precision Approaches", Invited Speaker: University of Texas McGovern Medical School, Houston, TX (November)
- 2018 "Precision Cut Lung Slices (PCLS): A human model for discovery of novel therapeutics", Invited Speaker: University of Washington School of Medicine, Seattle, WA (February)
- 2018 "Biological Therapies: Risks Vs Benefits", Invited Faculty, American Academy of Allergy, Asthma and Immunology, Orlando, FL (March)
- 2018 "Is Asthma/COPD Overlap Syndrome an Urban Myth?", Invited Speaker, Department of Medicine Grand Rounds, Penn State College of Medicine, Hershey, PA (April)
- 2018 "Airway Smooth Muscle and Inflammation: A Dangerous Liaison", Invited Speaker for lecture series "Excellence in Pulmonary and Critical Care Medicine, University of Colorado Anschutz Medical Campus, Aurora, CO (May)
- 2018 "The Role of Viral Infections in the Exacerbation of Asthma", "Problem-based case study: The Approach to Severe Persistent Asthma: When and Which Biologics?", "Biologics before Bronchial Thermoplasty – a Pro/Con Debate", "Future Novel Treatments of Airway Diseases", "Should We Treat GOLD "0", I and II?", Invited Speaker, Eastern Pulmonary Conference, Palm Beach FL (September)
- 2018 "Asthma Immunology", Invited Faculty, CHEST 2018 Severe Asthma Fellows Course, San Antonio, TX (October)
- 2018 "Future Novel Bronchodilators in Airway Disease", Invited Speaker, Institute of Physiology, University of Bonn, Bonn, Germany (October)
- 2018 "Biological Therapies: Risks and Benefits", Invited Speaker, Fondazione Internazional Menarini International Symposium on Complexity of Asthma and its Comorbidities, Bangkok, Thailand (November)
- 2019 "Asthma: Precision Approaches", Invited Speaker, Department of Family Medicine Grand Rounds, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ (February)
- 2019 "Remodeling Meets Airway Hyperresponsiveness", Invited Speaker, Department of Medicine Asthma and Airway Diseases Conference, Washington University St. Louis (March)
- 2019 "Precision Medicine: Better Medicine and Healthier Individuals", Invited Speaker, Robert Fl Johnston MD Memorial Lecture, Drexel University College of Medicine (April)
- 2019 "Asthma: Precision Approaches" and "Translational Targets for New Asthma Therapeutics", Invited Speaker, California Society of Allergy, Asthma and Immunology (June)
- 2019 "Real World Studies in Pulmonary Medicine: More Insight Beyond Randomized Controlled Trials?", Invited Speaker, Eastern Pulmonary Conference (September)
- 2019 "Navigating National Level Engagement: Why, When and How?", Invited Speaker, Young Investigator Meeting, Chicago (October)
- 2019 "Asthma Update: Precision Approaches", Keynote Speaker, 24<sup>th</sup> Annual Mary Parkes Center Asthma and Allergy Teaching Day, University of Rochester (November)
- 2020 "The Evolution of a Revolution: An NCATS Clinical and Translational Sciences Awardee", Invited Speaker, Tulane University Translational Science Institute (February)
- 2020 "Summary of the Rutgers Corona Cohort", Invited Speaker, Robert Wood Johnson Medical School Retired Faculty (June)
- 2020 "Con: Anti-IL5 therapies are NOT biologics of choice (over omalizumab or dupilumab) for severe eosinophilic asthma", Invited Speaker, Eastern Allergy Conference (July)
- 2020 "The Evolution of a Revolution: A Training Opportunity", Invited Speaker, Rutgers Health GME (November)
- 2021 "Translational Targets for New Asthma Therapeutics", Invited Speaker, Meakins-Christie Laboratories Research Seminar Series McGill University (February)
- 2021 "Biologics: Risks vs. Benefits in Severe Uncontrolled Asthma Problem-Based Learning(PBL): A Case of Severe Uncontrolled Asthma". Invited Speaker, 2021 AAAAI Virtual Annual Meeting (February)
- 2021 "NJ ACTS and Covid-19: What Do You Need to Know?", Invited Speaker, Robert Wood Johnson Medical School Retired Faculty (March)
- 2021 "Pharmacology of Inhaled  $\beta$ 2-agonists", Invited Speaker, 15<sup>th</sup> Annual International Nemacolin Asthma Conference, Farmington, PA (March)

- 2021 "Lessons Learned from a Large, Prospective COVID-19 Occupational Exposure Cohort". Invited Speaker, ATS Virtual Symposium (May)
- 2021 "Swimming Upstream in Severe ATS: New Pathways to Patient Management", ATS Virtual Symposium (May)
- 2021 "NJ ACTS Resources to Enhance Clinician Scientist Training", RWJMS (June)
- 2021 Research Day, Keynote Speaker, Robert Wood Johnson Medical School (July)
- 2021 "Asthma Education", New Jersey Medical School Pediatrics Grand Rounds (August)
- 2021 "Asthma Education", Robert Wood Johnson Medical School Family Medicine Grand Rounds (September)
- 2021 "Future biologics for asthma – Where do we stand?", Invited Speaker. Eastern Pulmonary Conference (September)
- 2021 "Case Study: PBL – 45-year-old asthmatic man with eosinophilia and pulmonary infiltrates", Session leader: Eastern Pulmonary Conference, Palm Beach, FL (September)
- 2021 "Future Biologics for COPD: Where do we stand?", Invited speaker. Eastern Pulmonary Conference, Palm Beach, FL (September)
- 2021 "Case Study: PBL – A 60-year-old man referred to you for evaluation of COPD and frequent exacerbations", Session leader: Eastern Pulmonary Conference, Palm Beach, FL (September)
- 2021 "B Agonists and Asthma: Something New, Something Old, Something...?", Invited Speaker. 2021 Hybrid International Asthma Conference at Nemacolin, Farmington, PA (October)
- 2021 "Biologic Medications for Severe Asthma are Effective in the Real-World, Including in Subgroups not Studies in Randomized Trials", Presenter. CHEST Annual Meeting 2021, Orlando, FL (October)
- 2021 "Effect of Once-Daily Single-Inhaler Fluticasone Furoate/Umeclidinium/Vilanterol Triple Therapy on Exacerbations Compared with Budesonide/Formoterol Dual Therapy in Patients with COPD and No History of Exacerbations: A Post Hoc Analysis of TH", Presenter. CHEST Annual Meeting 2021, Orlando, FL (October)
- 2021 "Benralizumab Real-World Effectiveness on Exacerbations Among US Specialist-Treated Patients With Severe Asthma: Data From CHRONICLE", Presenter. ACAAI 2021, New Orleans (November)
- 2021 "Cause for Alarm: New Avenues to the Management of Severe Asthma", Presenter. ACAAI 2021, New Orleans (November)
- 2021 "Omicron, Boosters, and Vaccines for Children", Featured Guest, COVID-19 Health Briefing with Chancellor Brian Strom, RBHS (December)
- 2022 "Airway Smooth Muscle Structure and Function in Health and Disease"Invited Speaker/Faculty USF 2022, Tampa FL (January)
- 2022 "Severe Asthma: Definition and Pathogenesis", Invited Speaker/Faculty USF 2022, Tampa FL (January)

#### Alternative Media

- Panettieri, R.A., Jr.**: Age and asthma (interview with Barbara Floria, editor). Vitality/Prime Time Supplement, Vol. 49, September 2006.
- Panettieri, R.A., Jr.**: Break free from asthma attacks (interview with Barbara Floria, editor). Vitality 20 (10):10-11, 2006.
- Panettieri, R.A., Jr.**: Health Quest Live Radio Program on Asthma, WURD 900 AM Talk Radio, October 24, 2006
- Panettieri, R.A., Jr.**: 33 10- to 15-Minute Radio and Satellite TV Interviews on Asthma and Allergy, April 28, 2008 (Market Locations Included: Columbia, SC; Monroe, MI; Rochester-Mason City, IA; Montgomery, AL; Columbus, OH; Lubbock, TX; Atlanta, GA; Charleston-Huntington, SC; Miami, FL; Philadelphia-Allentown, PA; Palm Springs, CA; Roanoke-Lynchburg, VA; Los Angeles, CA; Bakersfield, CA; Yuma, AZ; New York-Hudson Valley, NY; Tampa, FL; Boston, MA; Omaha, NE; Cleveland, OH; Wichita, KS; Quincy, MA; Minot-Bismarck, ND; Grand Rapids, MI)
- Panettieri, R.A., Jr.**: Radio Interview on Allergies and Asthma, Majic 102.3, Washington, DC, May 6, 2008
- Panettieri, R.A., Jr.**: Radio Interview, Your Health Matters (Lung Health Issues, Asthma, EPA Stats, Pollution), WGSL-FM, Greensboro, NJ, May 9, 2008
- Panettieri, R.A., Jr.**: Live TV Interview, Fox TV Morning Show in Philadelphia, May 26, 2008
- Tashkin, D., **Panettieri, R.A., Jr.**: Addressing the unmet needs in COPD. ReachMD XM Satellite Radio Broadcast, June 2009 (<http://reachmd.com>)
- Edgar, J. (Contributors: Rachelefsky, G., Johnson, D.K., **Panettieri, R.A., Jr.**): Outgrowing asthma: is remission possible? Web MD, [www.webmd.com/asthma/features](http://www.webmd.com/asthma/features).
- Panettieri, R.A., Jr.**: MSNBC Interview Re: Dangers of Third-Hand Smoke: Toxic Chemicals Linger Long After a Smoker Moves Out, <http://www.msnbc.msn.com/id/40704560/ns/health-addictions/>, December 2010

- Panettieri, R.A., Jr.**: National Media Interviews for Build Smart, Breathe Easier Program, New York City, May 2011
- Panettieri, R.A., Jr.**: Trouble Breathing? Grab Your Vacuum. Doctors on Call Blog, Men's Health, June 23, 2011 (<http://blogs.menshealth.com/doctors-on-call/trouble-breathing-grab-your-vacuum/2011/06/23/>)
- Panettieri, R.A., Jr.**: Interviewed by KYW/CBS3 I-Team Regarding Health Issues Associated with Mold Found in Hotel in Atlantic City, February 21, 2012 (<http://philadelphia.cbslocal.com/2012/02/27/i-team-hotel-mold-investigation/>)
- Panettieri, R.A., Jr.**: Reducing exacerbations in COPD. Physician's Weekly, Vol. 29, Issue No. 12, March 19, 2012 ([www.physweekly.com](http://www.physweekly.com)) .
- Panettieri, R.A., Jr.**: Taking sensible precautions with spray tans, Letter for Spa Business Magazine, 2013 1, page 14 (Managing Editor Katie Barnes, [www.spabusiness.com](http://www.spabusiness.com))
- Panettieri, R.A., Jr.**: 6ABC Interview Regarding Conrail Tanker Car Derailment in Mantua, NJ, 6ABC Investigative Reporter Wendy Saltzman, February 2013, ([http://abclocal.go.com/wpvi/story?section=news/special\\_reports&id=8999309](http://abclocal.go.com/wpvi/story?section=news/special_reports&id=8999309))
- Panettieri, R.A., Jr.**: Commentator in News Article, "Estimating Wastewater from Fracking in the Marcellus Shale," by Charles W. Schmidt, Environmental Health Perspectives, Tillett, T., Editor (February 2013)
- Panettieri, R.A., Jr.**: Interviewed for Discussant Video Appearing in Cardiac Risk May Increase with COPD Drugs by Charles Bankhead, MedPage Today, 5/21/13 (<http://www.medpagetoday.com/MeetingCoverage/ATS/39313>)
- Panettieri, R.A., Jr.**: A look at recidivism in COPD management. Physician's Weekly, Vol. 30, Issue No. 33, September 2, 2013, <http://www.physweekly.com/copd-recidivism>.
- Panettieri, R.A., Jr.**: Reducing readmissions in COPD. Physician's Weekly, Vol. 30, Issue No. 38, October 14, 2013, <http://www.physweekly.com/copd-reducing-readmissions>.
- Panettieri, R.A., Jr.**: Interviewed by Markham Heid of TIME Magazine for article entitled "You Asked: Are Self-Tanners Safe?", May 2015, <http://time.com/3896827/self-tanner-tanning-lotion/>
- Panettieri, R.A., Jr.**: Interviewed by Melanie Cole on RadioMD, "Are Spray Tans a Safe Alternative to Tanning Beds?" July 15, 2015, <http://radiomd.com/player/item/28464-are-spray-tans-a-safe-alternative-to-tanning-beds#.VazyEPISVAM>
- Panettieri, R.A., Jr.**: MedicalResearch.com Interview, "Study Finds Increased Hospitalizations Near Marcellus Shale Fracking Wells," July 17, 2015, <http://medicalresearch.com/author-interviews/study-finds-increased-hospitalizations-near-marcellus-shale-fracking-wells/15836/>
- Panettieri, R.A., Jr.**: The Conversation, "People Near Fracking Wells Show Higher Hospitalization Rates," July 20, 2015, <https://theconversation.com/people-near-fracking-wells-show-higher-hospitalization-rates-44755>
- Panettieri, R.A., Jr.**: Radio Interview Re: Study on Fracking and Hospital Visits, Vancouver Cooperative Radio, CFRO 100.5 FM, July 25, 2015
- Panettieri, R.A., Jr.**: Links to Articles Related to Publication of "Unconventional Gas and Oil Drilling Is Associated with Increased Hospital Utilization Rates," PLoS One, July 15, 2015:
- Penn Medicine News Release**  
[http://www.uphs.upenn.edu/news/News\\_Releases/2015/07/panetteri/](http://www.uphs.upenn.edu/news/News_Releases/2015/07/panetteri/)
- Philadelphia Inquirer Article**  
[http://www.philly.com/philly/health/20150116\\_Pa\\_studies\\_link\\_fracking\\_with\\_health\\_problems.html](http://www.philly.com/philly/health/20150116_Pa_studies_link_fracking_with_health_problems.html)  
<https://www.inquirer.com/health/dominican-republic-deaths-toxic-exposure-poisoning-20190613.html>
- Pittsburgh Post-Gazette Article**  
<http://powersource.post-gazette.com/powersource/policy-powersource/2015/07/15/Study-finds-those-living-near-Marcellus-shale-wells-more-likely-to-be-hospitalized-Pennsylvania/stories/201507150215>
- WHYY/StateImpact Article**  
<https://stateimpact.npr.org/pennsylvania/2015/07/15/study-shows-increased-hospitalizations-in-pennsylvania-shale-gas-region/>
- HealthDay Article**  
<http://consumer.healthday.com/environmental-health-information-12/environment-health-news-233/hospitalization-rates-jump-near-fracking-sites-study-701340.html>
- Newsweek.com Article**  
<http://www.newsweek.com/living-near-fracking-wells-linked-increased-hospitalization-rates-354093>
- Summit County Citizen's Voice**  
<http://summitcountyvoice.com/2015/07/16/study-tracks-spike-in-fracking-zone-health-problems/>
- The Independent (UK)**  
<http://www.independent.co.uk/environment/people-who-live-near-fracking-sites-suffer-higher-rates-of-heart-conditions-and-neurological-illnesses-says-research-10391339.html>
- The Morning Call Article**

<http://www.mccall.com/news/nationworld/pennsylvania/mc-pa-fracking-hospital-visits-20150719-story.html>

**Public News Service Article**

<http://www.publicnewsservice.org/2015-07-20/environment/new-report-links-fracking-to-increased-hospitalizations/a47235-1>

**From Quarks to Quasars Article**

<http://www.fromquarkstoquasars.com/researchers-seemingly-link-fracking-increase-hospitalizations/>

**Panettieri, R.A., Jr.:** Radio Interview Re: Cardiovascular Hospitalizations in Hydrofracking Areas, WPEL Radio, Montrose, PA, September 26, 2015

**Panettieri, RA, Jr.:** World Allergy Organization online learning module for CME: Bronchial Thermoplasty As an Option for Difficult-to-treat Severe Asthma. 2017

**Panettieri RA Jr.:** Two studies Evaluate Monoclonal Antibody Tralokinumab for Asthma. 2017, Interview. <https://medicalresearch.com/asthma/two-studies-evaluate-monoclonal-antibody-tralokinumab-for-asthma/42813/>

**Panettieri, RA Jr.:** Noetic Insight Blinded Panels, Invited Moderator, American Thoracic Society Annual Meeting, San Diego, CA (May)

**Panettieri, RA Jr.:** Annenberg Ceneter for Health Sciences "Updates in Precession Medicine: Elevating the Treatmentof Severe Eosinophilic Asthma", December 15, 2018<http://www.annenberg.net/CHEST-CME>

**Panettieri, RA Jr.:** Interviewed by Fox News "Toxicologist says a colorless, odorless 'intoxicant' could be cause of Dominican Republic deaths", June 21,2019 <https://www.foxnew.com/world/toxicologist-dominican-republic-deaths>

**Panettieri, RA Jr.:** Interviewed by Toledo Blade regarding death of tourists in Dominican Republic " Trouble in Paradise" <https://www.toledoblade.com/opinion/editorials/2019/06/27/trouble-in-paradise-deaths-tourism-dominican-republic/stories/20190627025.>

**Panettieri, RA Jr.:** Dominican Republic, CBS Local TV, New Jersey " Dominican Republic Tourist Deaths: New Jersey Man Becomes 8<sup>th</sup> American Case In Last Year", June 18, 2019 <https://newyork.cbslocal.com/2019/06/18/new-jersey-man-dies-in-dominican/>

**Panettieri, RA Jr.:** Health News Digest, "Researchers Discover Cause of Asthmatic Lung Spasms" [http://www.healthnewsdigest.com/news/Asthma\\_Issues\\_670/Researchers-Discover-Cause-of-Asthmatic-Lung-Spasms.shtml](http://www.healthnewsdigest.com/news/Asthma_Issues_670/Researchers-Discover-Cause-of-Asthmatic-Lung-Spasms.shtml), August 22, 2019.

**Panettieri, RA Jr.:** Science Codex, "Researchers Discover Cause of Asthmatic Lung Spasms" <https://www.sciencecodex.com/researchers-discover-cause-asthmatic-lung-spasms-632255>, August 22, 2019

**Panettieri, RA Jr.:** 7<sup>th</sup> Space, " Researchers Discover Cause of Asthmatic Lung Spasms" [http://7thspace.com/headlines/944850/researchers\\_discover\\_cause\\_of\\_asthmatic\\_lung\\_spasms.htm](http://7thspace.com/headlines/944850/researchers_discover_cause_of_asthmatic_lung_spasms.htm), August 22, 2019.

**Panettieri, RA Jr.:** Medicine News Line "Study Uncovers Cause of Asthmatic Lung Spasms" <https://medkit.info/2019/08/22/study-uncovers-cause-of-asthmatic-lung-spasms/>, August 22, 2019

**Panettieri, RA Jr.:** The Medical News " Study Uncovers Cause of Asthmatic Lung Spasms" <https://www.news-medical.net/news/20190822/Study-uncovers-cause-of-asthmatic-lung-spasms.aspx>, August 22, 2019

**Panettieri, RA Jr.:** Medical Xprss " Researchers Discover Cause of Asthmatic Lung Spasms" <https://medicalxpress.com/news/2019-08-asthmatic-lung-spasms.html>, August 22, 2019

**Panettieri, RA Jr.:** Science Magazine " Researchers Discover Cause of Asthmatic Lung Spasms" <https://scienmag.com/researchers-discover-cause-of-asthmatic-lung-spasms/>, August 22, 2019

**Panettieri, RA Jr.:** Rutgers Today " Researchers Discover Cause of Asthmatic Lung Spasms" <https://news.rutgers.edu/research-news/researchers-discover-cause-asthmatic-lung-spasms/20190819#.XWQ3PuhKiUm>, August 22, 2019

**Panettieri, RA Jr.:** NJ Biz " Researchers Discover Cause of Asthmatic Lung Spasms" <https://njbiz.com/researchers-discover-cause-of-asthmatic-lung-spasms/>, August 22, 2019

**Panettieri, RA Jr.:** RT Magazine "Researchers Take Closer Look At Cause of Asthmatic Lung Spasms" <http://www.rtmagazine.com/2019/08/asthmatic-lung-spasms/> August 23, 2019

**Panettieri, RA Jr.:** Drug Target Review "Researchers Discover Bronchospasms Mechanisms Using Microdevice" <https://www.drugtargetreview.com/news/48153/researchers-discover-bronchospasms-mechanisms-using-microdevice/> August 26, 2019

**Panettieri, Ra Jr.:** Futurity " Tiny Device Shows How Asthmatic Spasms Happen" <https://www.futurity.org/bronchospasm-asthma-muscle-contractions-2143012/> August 26, 2019

**Panettieri, Ra Jr.:** Whyy "Your Child Has Asthma, Now What?" <https://whyy.org/articles/your-child-has-asthma-now-what/> August 28, 2019

**Panettieri, Ra Jr.:** "Vaping: How much better Is the cure than the disease?"

<https://www.nj.com/opinion/2019/10/vaping-is-the-cure-worse-than-the-disease.html> October 20th, 2019

**Panettieri, Ra Jr.: BTN “Rutgers Looks to Revolutionize Asthma Treatment: BTN LIVEBIG”**

<https://btn.com/2020/03/04/rutgers-looks-to-revolutionize-asthma-treatment-btn-livebig/> February 27<sup>th</sup>, 2020

**Panettieri, Ra Jr.: “If You Live With Air Pollution, You’re Already More Vulnerable to Covid-19”**

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